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# Students' academic performances and least mastered skills as basis in developing learning modules for General Physics 1

**Melody B. Cornejo**

**Abstract**
The study focused on developing learning modules for General Physics 1 based on students' academic performance and validating its learning objectives, learning content, application, evaluation, clarity, presentation, navigation, and usefulness. The study employed a descriptive developmental design. It covers the analysis of the performance of Grade 12 Senior High School students at Quezon City University (QCU) under Science, Technology, Engineering, and Mathematics Strand in the subject General Physics 1 during the first semester of the Academic Year 2018-2019 and the evaluation of the developed learning modules by QCU science faculty members. The study revealed that the overall acceptability of the developed learning modules for General Physics 1 is "Highly Acceptable," and it is ready for utilization by the students. Using the developed learning modules for General Physics 1 is highly recommended to improve science teaching and learning.

**Keywords:** Learning Modules, Physics Education, Science Education, Learning Material Development and Validation.

## 1. Introduction

Today, we are living in an unpredictable world. Amid the Covid-19 pandemic, students from Local Colleges and Universities (LCUs), especially in Quezon City University (QCU), faced a hard time adjusting to the so-called "New Normal." The implemented community quarantine in the Philippines leads to the isolation of people and forces them to stay at home (Estacio et al., 2020). During community quarantine, schools were closed, and students had no choice to stay at home (Estacio et al., 2020). And the teaching and learning and the delivery of lessons shift to a new landscape where modules, online education, and blended learning are some prevalent modalities (Gordon, 2014; Kebritchi et al., 2017; Wu, 2021).

Thus, according to Wu (2021), teachers must recalibrate their methods and strategies for adapting and coping with changing situations. Physics is one of the most challenging subjects in the curriculum (Pullicino & Bonello, 2020). It is difficult because it requires one to master many concepts and skills directly related to mathematics which most students fear (Ebora, 2016; Erinosho, 2013). However, it is an exciting subject because it helps people understand how the world around them works. And discloses understanding and organizing the universe by simply dealing with fundamentals and letting others discover the patterns and connections between seemingly disparate phenomena (Bezzina, 2020).

Most of the students do not choose physics, but what they do not know is that Physics provides them with powerful tools in helping them to understand the world from a new perspective profoundly and then change it (Bezzina, 2020; Ebora, 2016; Erinosho, 2013). It provides the quantitative and analytical skills needed to analyze data and solve problems in engineering, medicine, economics, finance, management, law, and public policy. In addition, modern-day technology, tools, and instruments used in scientific, medical, and engineering research and development use physics principles. As a subject, it helps the students to see the entire perspective, and usually, it develops the skills in solving problems, most especially in those practical and real-life situations (Ebora, 2016).

While Physics opens new opportunities to many career options, teaching the subject effectively and learning it on the part of the students is a common phenomenon encountered by every classroom physics teacher (Ebora, 2016). There are key important factors to consider for the teaching-learning process, like the teachers who are facilitating the learning process, the students who are the receiver of information, instructions, and the learning environment. Among these factors, the role of the teacher dramatically affects the process (Estacio, 2015).

The success of the teaching-learning process depends on how the goals are achieved at the end of the lesson (Dayagbil et al., 2021). Thus, realizing these goals relies on the teacher who chooses the correct methodology and strategy, relevant instructional learning materials, and valid and reliable assessment tools (Dayagbil et al., 2021). The problem arises when the teaching methodology or process used is inappropriate, irrelevant instructional learning materials are used, and the assessment of the learning tool does not measure what it is supposed to measure (Camacho & Legare, 2016). There is no single best instructional method or strategy that can be used in the classroom or even correct or proper instructional learning materials because the whole process is dynamic (Camacho & Legare, 2016). Dynamic means that the class is composed of different types of learners, and therefore one method or strategy is effective to some but not to all (Estacio, 2015). Combining different methodologies or processes in one lesson proved to be more effective, especially in addressing multiple intelligences (Yavich & Rotnitsky, 2020).

On the other hand, aside from choosing the proper methodology or strategy, the teacher is also responsible for identifying what suitable instructional learning materials (IMs) will be used (Choppin et al., 2020). IMs are meant to help acquire knowledge or information in the class. When appropriately used, instructional learning materials support student learning (Choppin et al., 2020). When instructional learning materials are ineffective, the teaching itself defeats the purpose of learning (Roth McDuffie et al., 2018). Study reveals that instructional learning materials significantly affect students' performance and achievement, especially in science subjects (Abubakar, 2020). Selecting appropriate instructional learning materials for a specific topic will result in positive student performance (Choppin et al., 2020; Estacio, 2015; Roth McDuffie et al., 2018). Proper use of instructional learning material resulted in a meaningful classroom discussion, and most of the students gave positive feedback and enjoyed the lesson (Abubakar, 2020; Choppin et al., 2020; Estacio, 2015; Roth McDuffie et al., 2018).

And finally, to ensure that the goals were achieved, a good and reliable learning assessment tool is also considered (Francisco & Celon, 2020; MolokoMphale & Mhlauli, 2020). Assessment should meet the set goals or objectives. Most of the time, the form of the evaluation given by the teacher does not meet the set goals or objectives, and in the end, the teacher does not measure what they should measure after the class (Francisco & Celon, 2020; MolokoMphale & Mhlauli, 2020).

Today, the challenge in Science Education is on how to raise students' level of achievement. In the local scenario, students' performance in National Achievement Tests, specifically at the high school level, is far behind the 75%-mark goal (Department of Education, 2012). In the 2011-2012 National Achievement Test, the overall percentage of high school students is 48.9%, while the mean percentage score in Mathematics is 46.37%, while in Science 40.53% this data shows that aside from mathematics, science is the most challenging field of study in primary education (Department of Education, 2012).

At the international level, the performance of Filipino students in science lags among its Southeast Asian counterparts and other countries in the world. On various occasions, results of the Second International Science Study (SISS) and Third International Mathematics and Science Study (TIMSS) placed the Philippines in disadvantaged positions among nations that participated in these assessments (Department of Education, 2012; Luistro, 2012). In the SISS, the Philippines ranked almost at the bottom of the seventeen (17) nations that took part in this large-scale evaluation of educational achievement. Similar outcomes were revealed in 1995, 1999, and the recent 2003 TIMSS (Department of Education, 2012; Luistro, 2012).

The main factors which can be cited to account for the low performance in the science of the Filipino students include the lack of science culture and deficiencies regarding the school curriculum, the teaching-learning process, instructional learning materials, and teacher training (Orleans, 2009). Some of the primary roots of the unsatisfactory achievement of Filipino students are the congested curriculum, lack of textbooks and instructional learning materials, and lack of science laboratory and equipment (Luistro, 2012).

The literature revealed that using or integrating learning modules in science subjects such as physics positively affects students' learning and success (Abubakar, 2020; Ebora, 2016; Pullicino & Bonello, 2020). Moreover, studies showed that even though modular instruction meets today's learners' needs sufficiently compared to traditional education, both concerning the quality of learning and the content (Gordon, 2014; Kebritchi et al., 2017; Wu, 2021). Furthermore, using modules in a distant learning modality, especially during a pandemic, is very useful as an alternative way of delivering lessons to students (Abubakar, 2020; Choppin et al., 2020; Dayagbil et al., 2021; Estacio, 2015; Gordon, 2014; Kebritchi et al., 2017; Roth McDuffie et al., 2018; Wu, 2021). However, specific challenges may arise in how learning modules and similar materials were implemented (Dayagbil et al., 2021).

On the other hand, teachers become more reliant on modules when giving lectures (Cheng & Abu Bakar, 2017; Sadiq & Zamir, 2014; Selga, 2013), and students become dependent on modules as the only source of information (Richards, 2013). In addition, some studies revealed that the reliance on modules limits the creativity of lecturers and does not cater to the different learning styles and needs of the students (Rozano Suplet & Romero, 2016). Moreover, some studies revealed that modules might contain outdated information and are irrelevant to the level of learners, and it is not adequately designed for outcome-based learning.

Presenting physics lessons in a concise but straightforward manner is a big challenge on the part of the teacher, and understanding it is the responsibility of the learners. Primarily, this study aims to develop learning modules based on students' performances in the diagnostics test given to them. Specifically, it sought answers to the following questions:

1. Based on the diagnostic test results for General Physics 1, what is the level of performances of the Grade 12 Senior High School students under STEM strand and their least mastered learning competencies?
2. Based on the results, what learning material be developed?
3. How do science instructors assess the level of acceptability of the developed learning modules for General Physics 1 in terms of its learning objectives, learning content, application, evaluation, clarity, presentation, navigation, and usefulness?

## 2. Materials and Methods

The study used the descriptive developmental design (Fraenkel, Wallen & Hyun, 2019; Richey & Klein, 2015). In addition, in developing the learning modules for General Physics 1, Constructivist theory was used. Constructivists viewed that constructing meaning is learning, and it must be concerned with experiences and contexts that make the student willing and able to learn. Furthermore, the constructivist approach holds that learning is an active process of constructing rather than acquiring knowledge. Thus, instruction is a process of supporting that construction rather than communicating knowledge.

Since instruction supports the construction process, it must be structured so that the learner can easily understand it. The design of instruction should facilitate extrapolation and or fill in the gaps. Guided by the Constructivist theory in developing instructional learning materials, the study utilized the Input-Process-Output (IPO) Paradigm to address the pertinent problem under investigation (see figure 1).

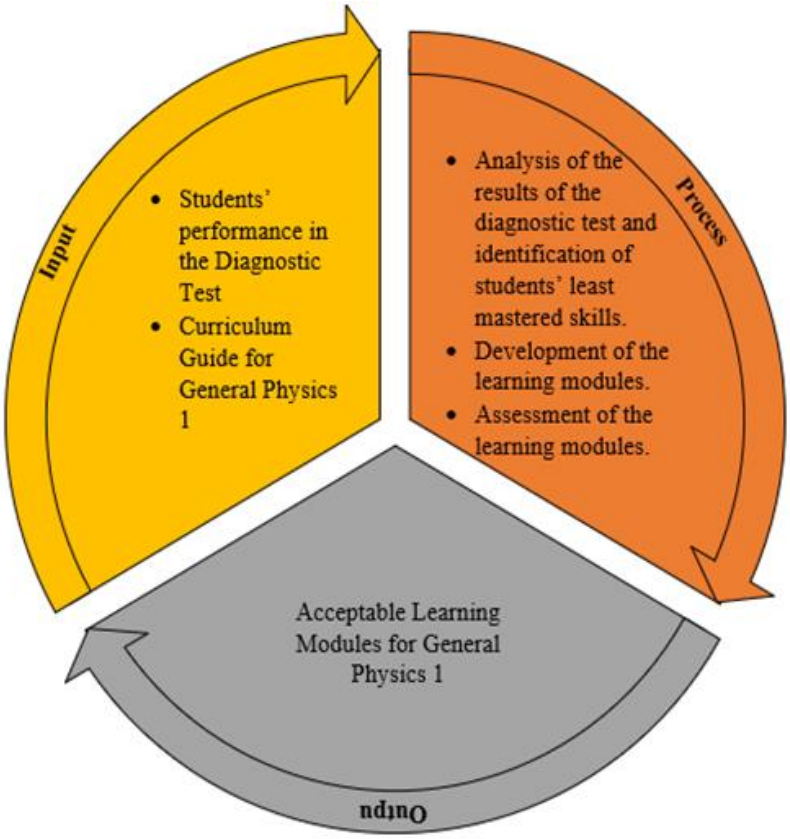


**Fig. 1:** The Research Paradigm of the Study (IPO Model).

The input of the study includes the performance of the Grade 12 Senior High School students under the Science, Technology, and Engineering (STEM) track in the subject General Physics 1 during the first semester of Academic Year 2018-2019 and their least mastered skills based on the results of the test given to them.

The diagnostic test results were used to determine the level of students' performances in General Physics 1 and their least mastered skills. The test validity was 0.758 (Cronbach's alpha) and composed of 50-item multiple-choice questions based on the Table of Specification (TOS) used by QCU SHS Science Department and Department of Education Curriculum Guide for the subject General Physics 1. Questions may fall into three cognitive levels based on the modified Bloom's taxonomy of educational objectives. The three modified cognitive levels were: knowledge, understanding and application, and higher mental processes. Topics include Kinematics: Motion Along Straight Line (10%); Motion in 2-D and 3-D (10%); Newton's Laws of Motion and Applications (10%); Work, Energy, and Energy Conservation (10%); Center of Mass, Momentum, Impulse, & Collision (10%); Gravity (8%); Periodic Motion (8%); Mechanical Waves and Sound (8%); Fluid Mechanics (8%); Temperature and Heat (8%); and Ideal Gases and the Laws of Thermodynamics (8%).

In developing the learning modules for General Physics 1, the researcher analyzed the diagnostic test results and identified the students' least mastered skills. And then, QCU science faculty members assessed the developed learning modules to establish the modules' acceptability.

The faculty respondents were determined using a purposive sampling technique. Science faculty members in Quezon City University were the most convenient and readily available to the researcher during the Covid19 pandemic and the implementation of the community quarantine in the Philippines. They primarily served as the respondents to

assess the acceptability of the developed learning modules. The study considers the age, gender, current position, length of service, and highest educational attainment of the teacher respondents.

To assess the developed learning modules, the researcher adopted the survey questionnaire used by Estacio in 2015 in his study about the development and validation of instructional learning material in Physics 1 (Mechanics) and modified it to satisfy the sub-problem presented in this study.

The questionnaire was composed of a series of questions that gathered the perception and assessment of the Science teachers in Quezon City University as to the acceptability of the developed learning modules for Physics in terms of its objective, learning content, application, evaluation, clarity, presentation, navigation, and usefulness. It made use of a structured questionnaire in the Likert format. This survey questionnaire provided five choices for every question or statement. The choices represented the degree of agreement each respondent had on the given question. The module evaluation checklist and the developed learning modules are presented to the respondents by the researcher during the evaluation phase.

To ensure the validity of the researcher-created survey questionnaire, the researcher seeks the help of experts in science education to evaluate the content of the questionnaire in terms of format, language used, and whether the questions measured the desired objectives. The final copy of the survey questionnaire includes the suggestions and comments of the experts. To establish the survey questionnaire's reliability, the researcher asked a total of fifteen (15) Senior High School Science Teachers, who are not part of the survey, to answer the final copy of the survey questionnaire and perform the Cronbach alpha test to determine the evaluation checklist's reliability. The computed Cronbach alpha value was 0.868, indicating that the survey questionnaire was reliable and ready for use.

After retrieving the survey questionnaire, the teachers' responses were tallied, tabulated, and analyzed by the researcher using IBM SPSS Statistics version 22. And lastly, based on the paradigm of the study, the output was an acceptable Learning Modules for General Physics 1.

## 3. Results and Discussion

The study focused on developing learning modules for the subject General Physics 1 based on students' academic achievements and validating it in terms of objectives, learning content, application, evaluation, clarity, presentation, navigation, and usefulness. The following sub-sections discussed the results of the study.

### Performance and the least mastered skills of the Grade 12 Senior High School students under STEM strand in General Physics 1 based on the diagnostic test results.

Students' performance in science subjects can be determined through various ways, such as traditional methods like formal tests, quizzes, and exams. The results of the diagnostic test for General Physics 1 given to SHS students at QCU under STEM track revealed that most of the students performed "Satisfactory" (see Table 1).

**Table 1:** Performance of STEM Students in General Physics 1.

| Descriptor | Range | F | % | Rank |
|---|---|---|---|---|
| Outstanding | 90 – 100 | 10 | 4.26 | 5 |
| Very Satisfactory | 85 – 89 | 25 | 10.64 | 4 |
| Satisfactory | 80 – 84 | 40 | 17.02 | 3 |
| Fairly Satisfactory | 75 – 79 | 105 | 44.68 | 1 |
| Did Not Meet Expectations | 74 – below | 75 | 31.91 | 2 |
| **Total** | | **235** | **100.00** | |

Table 1 shows the level of performance of the Senior High School students in Quezon City University under STEM strand in the subject General Physics 1. Most of the students were found to be relatively satisfactorily met the requirements in the subject General Physics 1. A total of one hundred five (105) students or equivalent to 44.68%, got a reasonably "*Fairly Satisfactory*" rating in the diagnostic test given to them. In addition, there are seventy-five (75) or 31.91% STEM students could not meet the expectations of the subject General Physics 1, as revealed by the results of their diagnostic test. Moreover, a total of forty (40) students or 17.02%, fall in the "*Satisfactory"* level, which means that their scores in the diagnostic test are between 80 to 84 percent. However, twenty-five (25) or 10.64% of the students got a final mark between 85 to 89 percent, which is considered "*Very Satisfactory*", while there are ten (10) or 4.26% of the students fall in the "*Outstanding*" category.

The mean score of the students in the diagnostic test given to them is presented in Table 2.

**Table 2:** Mean Score of the Diagnostic Test in General Physics 1.

| Group | N | Mean ($\bar{X}$) | Standard Deviation (SD) |
|---|---|---|---|
| Grade 12 STEM Students | 235 | 27.74 | 6.67 |

Table 2 revealed that the students' scores in the diagnostic test were slightly higher than the passing score, which is 25 points, which means that students' prior knowledge in General Physics 1 is somewhat relatively poor, as revealed by their mean score (M=27.75). The standard deviation of 6.67 denotes that the scores of the students were spread out over a range of values.

Tables 1 and 2 revealed that despite the efforts made by the teachers to help the students to improve and develop students' skills in science, most of them need proper attention and training so that they will reach outstanding or, at the very least, very satisfactory level of performance. Similarly, the above data shows that students' level of commissions, especially in General Physics 1, is considered flawed. According to Li (2019), Li (2018), Lin, et al. (2019), Margot and Kettler, (2019), and Thibaut, et al. (2018), the low performance of students in the subject is brought by several external and internal factors. The poor academic performance of STEM students in Quezon City University in General Physics 1 is almost the same as that of students in the subject Physics in general.

After careful analysis of the results of the diagnostic test in General Physics 1 given to the students, Table 3 summarizes the least mastered skills of the students.

**Table 3:** Least Mastered Skills in General Physics 1.

| Topic | Leaning Competencies | f | % | Rank |
|---|---|---|---|---|
| **Kinematics: Motion Along a Straight Line** | Solve for unknown quantities in equations involving one-dimensional uniformly accelerated motion; and | 115 | 48.94 | 4 |
| | Solve problems involving one-dimensional motion with constant acceleration in contexts such as, but not limited to, the "tail-gating phenomenon," pursuit, rocket launch, and free-fall problems. | 121 | 51.49 | 1 |
| **Kinematics: Motion in 2- Dimensions and 3-Dimensions** | Calculate range, time of flight, and maximum heights of projectiles; and | 108 | 45.96 | 8 |
| | Solve problems involving two-dimensional motion in contexts such as, but not limited to ledge jumping, movie stunts, basketball, safe locations during firework displays, and Ferris wheels. | 118 | 50.21 | 2 |
| **Work, Energy, and Energy Conservation** | Solve problems involving work, energy, and power in contexts such as, but not limited to, bungee jumping, design of rollercoasters, number of people required to build structures such as the Great Pyramids and the rice terraces; power and energy requirements of human activities such as sleeping vs. sitting vs. standing, running vs. walking. (Conversion of joules to calories should be emphasized at this point.). | 113 | 48.09 | 5 |
| **Center of Mass, Momentum, Impulse, and Collisions** | Calculate magnitude and direction of torque using the definition of torque as a cross-product. | 117 | 49.79 | 3 |
| **Temperature and Heat** | Solve problems involving temperature, thermal expansion, heat capacity, heat transfer, and thermal equilibrium in contexts such as, but not limited to, the design of bridges and train rails using steel, the relative severity of steam burns and water burns, thermal insulation, sizes of stars, and surface temperatures of planets. | 111 | 47.23 | 7 |
| **Ideal Gases and the Laws of Thermodynamics** | Solve problems involving ideal gas equations in contexts such as, but not limited to, the design of metal containers for compressed gases; | 103 | 43.83 | 10 |
| | Solve problems involving the application of the Second Law of Thermodynamics in a context such as, but not limited to, heat engines, heat pumps, internal combustion engines, refrigerators, and fuel economy. | 106 | 45.11 | 9 |

**N = 235 students**

Table 3 revealed that STEM students have difficulty achieving scientific and mathematical competencies such as computing, graphing, and interpreting. Table 3 revealed that students' least mastered skills are under the topics of measurement, vectors, kinematics, Newton's Laws of Motion and its applications, work, energy, and energy conservation, the center of mass, momentum, impulse, and collisions, gravity, periodic motion, mechanical waves and sound, fluid mechanics, temperature and heat, ideal gases, and the Laws of Thermodynamics.

After careful analysis of the results of the diagnostic test, the researcher found out that most of the students did not feel able to answer questions involving solving problems about one-dimensional motion with constant acceleration, a total of 121 out of the 235 students (or 51.49%) who took the test did not get the correct answer for this competency. In addition, most of them did not feel able to solve problems involving two-dimensional motion in contexts such as, but not limited to, ledge jumping, movie stunts, basketball, safe locations during firework displays, and Ferris wheels (50.21%). Furthermore, students did not feel able to calculate the magnitude and direction of torque using the definition of torque is a cross-product (49.79%).

Table 3 also showed that 48.94 % of the students could not solve for unknown quantities in equations involving one-dimensional uniformly accelerated motion, 48.09% were not able to solve problems involving work, energy, and power.

Other least mastered skills of the students in General Physics 1 are: Solving problems that involves temperature, thermal expansion, heat capacity, heat transfer, and thermal equilibrium in contexts such as, but not limited to, the design of bridges and train rails using steel, relative severity of steam burns and water burns, thermal insulation, sizes of stars, and surface temperatures of planets; calculating the range, time of flight, and maximum heights of projectiles; solving problems that involves the application of the Second Law of Thermodynamics in context such as, but not limited to, heat engines, heat pumps, internal combustion engines, refrigerators, and fuel economy; solving problems that involves ideal gas equations in contexts such as, but not limited to, the design of metal containers for compressed gases; calculating the efficiency of a heat engine; and applying work-energy theorem to obtain quantitative and qualitative conclusions regarding the work done, initial and final velocities, mass and kinetic energy of a system.

**Learning modules developed for General Physics 1**

Based on the analysis of the diagnostic test results and least mastered skills of the Grade 12 STEM Senior High School students in General Physics 1, the researcher developed learning modules for General Physics 1 to improve students' cognitive skills and the science teaching-learning process.

The arrangement of topics found in the modules follows the Curriculum Guide set by the Department of Education for the subject General Physics 1. The learning modules include the following essential features:

- Learning through Diagrams. The lesson is presented in a modified concept map to understand the concept better. Diagrams and pictures supplement the text.
- Unit Opener. Each unit provides an outline and learning objectives to guide the learner and the teacher.
- Summarizing Your Ideas. One of the essential parts of learning material is the end unit summary. Each unit provides an opportunity for students to summarize what they learned after the unit discussion utilizing a concept map.
- Process Skills Worksheet. The questions found in the worksheets are presented in a Concept Cartoon, emphasizing the process skills-based questions.

Concept cartoons aid the instructors in identifying students' misconceptions about the topic and, at the same time, correcting these misconceptions through classroom discussions and interactions.

- Learning Banks. To express students' understanding of each lesson, Learning Bank provides an opportunity to process information and apply what they have learned.
- Time-tested Activities. Learning-by-doing is one of the main objectives of developing the modules. Each chapter provides group activities and experiments to verify concepts, scientific laws, and principles and facilitate an active learning process.
- Online Search. As a 21st century learner, this work-text recognizes the importance of the World Wide Web. Suggested videos and useful websites are found in each unit opener to provide a dose of information related to the topic.
- Notebox. Blank space is designated on the right side of each page to jot down notes during the discussion. This feature maximizes the physical use of this work-text instead of using a separate notebook in writing essential letters. This portion will suffice the need.
- Rubric Guide. It will help the teachers to assess the students' performances, and it also provides a clear idea for the learners on what that teacher expects from them.

**Acceptability of the developed learning modules in General Physics 1**

The teacher respondents evaluated the acceptability of the developed learning modules in General Physics 1 in terms of the learning objectives, content, application of the material, the evaluation used, clarity of the content, lesson or concept presentation, navigation, and usefulness.

**Learning Objectives**

In designing and developing the learning modules for General Physics 1, one must begin with ends in mind. Setting learning objectives or goals will help the instructional learning material developer or designer produce excellent and valuable material. Table 4 provides the results of evaluating the science faculty members of QCU towards the acceptability of the developed learning modules for General Physics 1.

**Table 4:** Acceptability of the Learning Modules in General Physics 1 in terms of Learning Objectives.

| Criteria | Mean | SD | Verbal Interpretation | Rank |
|---|---|---|---|---|
| 1. Learning objectives are clearly stated in each lesson and are aligned to the K to 12 Curriculum Guide. | 4.13 | 1.85 | Highly Acceptable | 2 |
| 2. Learning objectives can change students' behavior and develop students to become 21st-century life-long learners. | 4.00 | 2.24 | Highly Acceptable | 3 |
| 3. Learning objectives provide learning opportunities and experiences. | 4.25 | 2.33 | Highly Acceptable | 1 |
| 4. Learning objectives are appropriate within the student's level and can be achieved within a given time frame. | 3.88 | 1.85 | Highly Acceptable | 4 |
| 5. Learning objectives are complete and sufficient to improve students' performances and achievements in Physics. | 3.75 | 2.33 | Highly Acceptable | 5 |
| **Over-all Weighted Mean** | **4.00** | **2.14** | **Highly Acceptable** | |

Table 4 revealed that in terms of the learning objectives found in the modules, science faculty members said it was "Highly Acceptable" with a computed overall weighted mean of 4.00 and standard deviation of 2.14. The small value of the standard deviation denotes that the response of the science faculty members was almost closer to the value of the mean. Specifically, respondents said that the learning objectives provide learning opportunities and experiences and are considered "Highly Acceptable," with a computed mean value of 4.25 and a standard deviation of 2.33. In addition, respondents said that the learning objectives are clearly stated in each lesson and are aligned to the K to 12 Curriculum Guide and described as "Highly Acceptable," with the computed mean value of 4.13 and a standard deviation of 1.85.

Moreover, respondents said that when it comes to the concept that the learning objectives found in the modules can change students' behavior and develop students to become 21st-century life-long learners, it is "Highly Acceptable," as revealed by the computed mean of 4.00 and a standard deviation of 2.24. Respondents also said that the learning objectives are appropriate within the student's level and can be achieved within a given time frame and described as "Highly Acceptable" with a computed mean value of 3.88 and a standard deviation of 1.85. And lastly, when it comes to the idea that the learning objectives are complete and sufficient to improve students' performances and achievements in Physics, respondents said that the developed modules are "Highly Acceptable" with a computed mean value of 3.75 and a standard deviation of 2.33.

The results provide the basis to develop and improve the learning objectives found in the learning modules for General Physics 1. According to Abubakar (2020), Ebora (2016), and Pullicino and Bonello (2020), an excellent instructional learning material should promote specific desired results and should stimulate interest, command attention, be easily understood, and promote a positive reaction on the part of the students.

**Learning Content**

The alignment of the content and the lesson's objectives is essential in every learning material. It should provide varied and flexible activities to enhance the learners' cognitive, psychomotor, and affective skills. Table 5 provides the results of the assessment made by the respondents towards the learning content of the developed learning modules in General Physics 1.

Regarding the content of the developed learning modules, respondents said that the modules in General Physics 1 are "Highly Acceptable" with a computed overall weighted mean value of 4.20 and a standard deviation of 2.17. Table 5 revealed that the learning contents of the modules are "Highly Acceptable" when it comes to providing opportunities and experiences to improve students' cognitive, psychomotor, and affective skills with a

computed mean value of 4.38 and a standard deviation 2.06. Lastly, respondents agreed that the developed learning modules are "Highly Acceptable" when it comes to the idea of completeness. Respondents further decided that the content is sufficient, covering the topics found in the k to 12 Curriculum Guide for Physics 1 and consisting of appropriate and relevant diagrams to enhance students' understanding and problem-solving skills with a computed mean value of 4.25 and standard deviation of 2.33.

**Table 5:** Acceptability of the Learning Modules in General Physics 1 in terms of Learning Content.

| Criteria | Mean | SD | Verbal Interpretation | Rank |
|---|---|---|---|---|
| 1. Learning contents are sufficient and complete covering the topics based on the k to 12 Curriculum Guide for Physics 1. | 4.25 | 2.33 | Highly Acceptable | 2.5 |
| 2. Learning contents provide opportunities and experiences to improve students' cognitive, psychomotor, and affective skills. | 4.38 | 2.06 | Highly Acceptable | 1 |
| 3. Material consists of appropriate and relevant diagrams to enhance students' understanding and problem-solving skills. | 4.25 | 2.33 | Highly Acceptable | 2.5 |
| 4. Material provides a variety of activities that are suited to students' individual needs. | 4.13 | 1.85 | Highly Acceptable | 4 |
| 5. Material/s utilized are sufficient, adequately presented and/or labeled, and relevant to the lesson or topic. | 4.00 | 2.24 | Highly Acceptable | 5 |
| **Over-all Weighted Mean** | **4.20** | **2.17** | **Highly Acceptable** | |

Furthermore, respondents agreed that the learning content of the material provides a variety of activities that are suited to students' individual needs and is "Highly Acceptable" with a computed mean value of 4.13 and a standard deviation of 1.85, as revealed in Table 5. And lastly, respondents agreed that the learning modules in General Physics 1 are "Highly Acceptable" as they utilize sufficient materials that support learning, are adequately presented and labeled, and are relevant to the lesson or topic with a computed mean value of 4.00 a standard deviation of 2.24.

The result provides an avenue to improve the content found in the developed learning modules. According to Abubakar (2020), Ebora (2016), and Pullicino and Bonello (2020), the content of the modules and the way how it presents is very crucial, and it generally influences the learner during the learning process. In addition, learning content provides an opportunity for the learners to acquire the necessary skills needed at their level.

**Application of the Learning Modules**

Practical application and usefulness of learning material are essential to teachers and the direct receiver of the material, the students. Table 6 provides the assessment made by QCU Science faculty members towards applying the developed learning modules.

**Table 6:** Acceptability of the Learning Modules in General Physics 1 in terms of Application.

| Criteria | Mean | SD | Verbal Interpretation | Rank |
|---|---|---|---|---|
| 1. Material provides a practical application that students can be used in everyday life. | 4.00 | 2.24 | Highly Acceptable | 3 |
| 2. Material is suitable for different types of learners. | 3.88 | 1.85 | Highly Acceptable | 4 |
| 3. Material is used to address problems faced by the traditional mode of teaching. | 4.38 | 2.06 | Highly Acceptable | 1 |
| 4. Material is flexible and can be used online and offline. | 4.25 | 2.33 | Highly Acceptable | 2 |
| 5. Material is effective in developing students' skills (cognitive, psychomotor, and affective). | 3.75 | 2.33 | Highly Acceptable | 5 |
| **Over-all Weighted Mean** | **4.05** | **2.17** | **Highly Acceptable** | |

Table 6 showed that in terms of applying the learning modules in General Physics 1, respondents agreed that it is "Highly Acceptable" with a computed overall weighted mean value of 4.05 and a standard deviation of 2.17. It can be gleaned from the respondents agreed that the material is used to address problems faced by the traditional mode of teaching and is "Highly Acceptable," as revealed with the computed mean value of 4.38 and a standard deviation of 2.06. Respondents also agreed that the material is "Highly Acceptable" in terms of its flexibility and applicability in an online and offline learning environment, with a computed mean value of 4.25 and a standard deviation of 2.33. In addition, respondents agreed that the material provides a practical application that students can be used in everyday life and is "Highly Acceptable," as revealed with the computed mean value of 4.00 and a standard deviation of 2.24.

Moreover, the material is suitable for different learners and considered "Highly Acceptable," with a computed mean value of 3.88 and a standard deviation of 1.85, as shown in Table 6. Lastly, the respondents agreed that the material is "Highly Acceptable" in developing students' skills (cognitive, psychomotor, and affective) with a computed mean value of 3.75 and a standard deviation of 2.33.

The above results served to improve the developed learning modules in General Physics 1. In addition, the results are congruent to Nana Sepriyanti and Prihartini (2018) that instructional learning material should help build the learners' skills, both cognitive and affective. Moreover, it should be applicable, complete, have some explanation in the form of a label, and finally be as simple as possible.

**Evaluation**

A practical learning module should be complete and accompanied by a relative assessment tool to measure the learners' success after using it. Table 7 provides the assessment made by the respondents towards the acceptability of the developed learning modules in terms of its evaluation.

**Table 7:** Acceptability of the Learning Modules in General Physics 1 in terms of Evaluation.

| Criteria | Mean | SD | Verbal Interpretation | Rank |
|---|---|---|---|---|
| 1. Evaluation is sufficient to determine if the transfer of learning occurs. | 3.63 | 2.06 | Highly Acceptable | 5 |
| 2. Directions, instructions, and problem statements are simple and easy to follow. | 4.38 | 2.06 | Highly Acceptable | 1.5 |
| 3. Evaluation is complete to determine the students' acquisition of knowledge of concepts, understanding of scientific laws and principles, and skills in applying scientific laws and principles. | 3.75 | 2.33 | Highly Acceptable | 4 |
| 4. Evaluation measures the learning competencies and performance standards given in the k to 12 curriculum guides for Physics 1. | 4.38 | 2.06 | Highly Acceptable | 1.5 |
| 5. Evaluation used is relevant and appropriate to each topic being presented and within students' level of comprehension. | 4.00 | 2.24 | Highly Acceptable | 3 |
| **Over-all Weighted Mean** | **4.05** | **2.17** | **Highly Acceptable** | |

Table 7 shows the acceptability of the developed learning modules in General Physics 1 in the evaluation used. Respondents agreed that the assessment used in the learning modules is "Highly Acceptable," with a computed mean value of 4.03 and a standard deviation of 2.15.

Respondents agreed that they are simple and easy to follow regarding the instructions and problem statements of the evaluation and assessment used in the modules. It measures the learning competencies and performance standards given in the k to 12 curriculum guides for General Physics 1with a computed mean value of 4.38 with a standard deviation of 2.06 and interpreted as "Highly Acceptable." In addition, the evaluation used is relevant and appropriate to each topic and within students' level of comprehension and "Highly Acceptable" according to the respondents with a computed mean value of 4.00 and a standard deviation of 2.24.

Moreover, Table 7 shows that the respondents agreed that the evaluation is sufficient to determine if the transfer of learning occurs with a computed mean value of 3.63 and a standard deviation of 2.06 and interpreted as "Highly Acceptable." Lastly, the evaluation used in the modules is "Highly Acceptable" (M=3.75; SD=2.33) and complete to determine the students' acquisition of knowledge of concepts, understanding of scientific laws and principles, and skills in applying scientific laws and principles.

The result conforms to the idea of Auditor and Naval (2014) that a good test, assessment, or evaluation represents something beyond how students perform on a specific task or a particular set of items, and they illustrate how a student performs on the objective which those items were intended to assess.

**Clarity**

Since the learning modules cater to senior high school students, the content should be presented clearly to understand them. Table 8 provides the results of the QCU science faculty member's assessment of the developed learning modules in General Physics 1 in terms of clarity.

**Table 8:** Acceptability of the Learning Modules in General Physics 1 in terms of Clarity.

| Criteria | Mean | SD | Verbal Interpretation | Rank |
|---|---|---|---|---|
| 1. Presentation of concepts, laws, and principles of science is clear and within the level of the students. | 4.25 | 2.33 | Highly Acceptable | 2 |
| 2. Activities are presented in a simple yet concise manner that students can perform and work independently. | 4.00 | 2.24 | Highly Acceptable | 4 |
| 3. Language used is clear, brief, and within the level of students' understanding. | 4.50 | 1.96 | Very Highly Acceptable | 1 |
| 4. Suggested materials (files, videos, diagrams, etc.) found in the modules were appropriate and straightforward to the discussed concepts and principles. | 3.88 | 1.85 | Highly Acceptable | 5 |
| 5. The material is based on the k to 12 Curriculum Guide, which can develop students' self-confidence and skills. | 4.13 | 1.85 | Highly Acceptable | 3 |
| **Over-all Weighted Mean** | **4.15** | **2.06** | **Highly Acceptable** | |

The overall weighted mean of the response made by the respondents towards clarity of the contents of the learning module is 4.15 (SD=2.06) and interpreted as "Highly Acceptable."

Table 8 shows that respondents agreed that the developed modules for General Physics 1 used clear and brief language to explain key concepts in Physics. It also used language within the level of students' understanding and is "Very Highly Acceptable," with a computed mean value of 4.50 and a standard deviation of 1.96. According to the respondents, the presentation of concepts, laws, and science principles is straightforward and within the level of the students with a computed mean value of 4.25 (SD=2.33) and interpreted as "Highly Acceptable." In addition, according to the respondents, the material is based on the k to 12 Curriculum Guide, which can develop students' self-confidence and skills and is considered "Highly Acceptable" with a computed mean value of 4.13 (SD=1.85).

Furthermore, according to the respondents, the activities found in the modules are presented in a concise yet straightforward manner that students can perform and work independently and is "Highly Acceptable" with a computed mean value of 4.00 and a standard deviation of 2.24. Lastly, the suggested materials (files, videos, diagrams, etc.) found in the modules were appropriate and straightforward to the concepts and principles being discussed and are "Highly Acceptable" according to the respondents with a computed mean value of 3.88 and a standard deviation of 1.85.

**Presentation**

Table 9 provides the results of the assessment made by the respondents towards the developed learning modules for General Physics 1. The overall weighted mean of the evaluation made by the respondents towards the presentation of the lesson found in the modules is 4.55 (SD=2.15) and interpreted as "Very Highly Acceptable."

**Table 9:** Acceptability of the Learning Modules in General Physics 1 in terms of Presentation.

| Criteria | Mean | SD | Verbal Interpretation | Rank |
|---|---|---|---|---|
| 1. Topics are presented sequentially based on the k to 12 Curriculum Guide for Physics 1. | 4.50 | 1.96 | Very Highly Acceptable | 4 |
| 2. Topics are well-organized that teachers and students can use independently and adequately. | 4.63 | 2.06 | Very Highly Acceptable | 2.5 |
| 3. Parts consist of lesson title, learning objectives, introduction, content, evaluation, and application. | 4.75 | 2.33 | Very Highly Acceptable | 1 |
| 4. Diagrams, animation, videos, and links can motivate students' interests, curiosity, and awareness. | 4.25 | 2.33 | Highly Acceptable | 5 |
| 5. Presentation of scientific concepts is simple. | 4.63 | 2.06 | Very Highly Acceptable | 2.5 |
| **Over-all Weighted Mean** | **4.55** | **2.15** | **Very Highly Acceptable** | |

Table 9 revealed that respondents said that the modules are "Very Highly Acceptable" as it includes essential parts such as lesson title, learning objectives, introduction, content, evaluation, and application (M=4.75; SD=2.33). In addition, respondents agreed that the developed learning modules are "Very Highly Acceptable" in terms of the organization of the topics. Respondents agreed that teachers and students could use the modules independently and adequately due to their simplicity and clarity (M=4.63; SD=2.06).

In addition, the topics on each module are presented sequentially based on the k to 12 Curriculum Guide for Physics 1 according to the respondents, with a computed mean value of 4.50 (SD=1.96) and interpreted as "Very Highly Acceptable." Lastly, respondents agreed that the diagrams, animation, videos, and links utilized in the modules are "Highly Acceptable" and can motivate students' interests, curiosity, and awareness, as revealed by the computed mean value of 4.25 and a standard deviation of 2.33.

The above results provide an avenue to improve the overall presentation of the developed learning modules. According to Estacio (2015), another essential part of the instructional learning material is presenting multiple perspectives to learners.

**Navigation**

Table 10 shows the acceptability of the learning modules in General Physics 1 in terms of navigation. Based on the table, respondents agreed that it is "Highly Acceptable" with a computed mean value of 4.43 and a standard deviation of 1.92.

Furthermore, table 10 showed that the respondents agreed that the topics could be found easily throughout the material and considered "Very Highly Acceptable," with a computed mean value of 4.75 and a standard deviation of 2.33. In addition, they agreed that moving back and forth from one page to the next is smooth and easy and considered to be "Very Highly Acceptable," with a computed mean value of 4.63 and a standard deviation of 2.06.

**Table 10:** Acceptability of the Learning Modules in General Physics 1 in terms of Navigation.

| Criteria | Mean | SD | Verbal Interpretation | Rank |
|---|---|---|---|---|
| 1. Teachers and students can navigate the material quickly. | 4.38 | 1.62 | Highly Acceptable | 3 |
| 2. Moving back and forth from one page to the next is smooth and easy. | 4.63 | 2.06 | Very Highly Acceptable | 2 |
| 3. Topics can easily be found throughout the material. | 4.75 | 2.33 | Very Highly Acceptable | 1 |
| 4. Overall design such as color, font, and diagrams are helpful to navigate and scan the material. | 4.25 | 1.62 | Highly Acceptable | 4 |
| 5. The design of the material allows the user to recognize each chapter easily. | 4.13 | 1.85 | Highly Acceptable | 5 |
| **Over-all Weighted Mean** | **4.43** | **1.92** | **Highly Acceptable** | |

The developed learning modules in General Physics 1 are "Highly Acceptable" in terms of the idea that the teachers and students can navigate the material easily with a computed mean value of 4.38 and a standard deviation of 1.62. Furthermore, the overall design, such as color, font, and diagrams that help navigate and scan the material, is said to be "Highly Acceptable" with a computed mean value of 4.25 and a standard deviation of 1.62, as shown in Table 10. Lastly, respondents agreed that the material design allows the user to easily recognize each chapter with a computed mean value of 4.13 (SD=1.85) and interpreted as "Highly Acceptable."

The above results allow the researcher to improve and develop a more user-friendly instructional learning material. According to Abubakar (2020), Ebora (2016), and Pullicino and Bonello (2020), a learning module should be user-friendly and provide a learning environment suitable to the level and interest of the learners.

**Usefulness**

The overall weighted mean of the response of the science faculty member of the Mathematics and Science Department of the Quezon City University towards the acceptability of the learning modules in General Physics 1

in terms of its usefulness is 4.70 with a standard deviation of 2.30 and interpreted as "Very Highly Acceptable," shown in Table 11.

According to the respondents, the material helps apply various teaching strategies to meet students' needs and levels of capabilities. Accordingly, it is considered "Very Highly Acceptable," with a computed mean value of 4.88 and a standard deviation of 2.73.

In addition, the developed learning modules are "Very Highly Acceptable" (Mean, 475; SD, 2.33) when it comes to improving students' achievement. Respondents also agreed that the modules contain activity-oriented materials where students can work and apply what they have learned in everyday life.

Lastly, respondents agreed that the developed learning modules are "Very Highly Acceptable" and helpful in developing the students' cognitive, exploratory, and affective skills (M=4.63; SD=2.06). And developing students' understanding of scientific laws and principles widens students' scientific and logical ability (M=4.50; SD=1.96).

**Table 11:** Acceptability of the Learning Modules in General Physics 1 in terms of Usefulness.

| Criteria | Mean | SD | Verbal Interpretation | Rank |
|---|---|---|---|---|
| 1. The learning material is instrumental in developing students' cognitive, exploratory, and affective skills and understanding of scientific laws and principles. | 4.63 | 2.06 | Very Highly Acceptable | 4 |
| 2. The learning material is very useful to improve students' achievement. | 4.75 | 2.33 | Very Highly Acceptable | 2.5 |
| 3. The learning material widens and deepens students' scientific and logical abilities. | 4.50 | 1.96 | Very Highly Acceptable | 5 |
| 4. The material is activity-oriented to work and apply what they have learned in everyday life. | 4.75 | 2.33 | Very Highly Acceptable | 2.5 |
| 5. The material helps apply various teaching strategies to meet students' needs and capabilities. | 4.88 | 2.73 | Very Highly Acceptable | 1 |
| **Over-all Weighted Mean** | **4.70** | **2.30** | **Very Highly Acceptable** | |

The above results allow the researcher to provide a more suitable learning material to develop and improve students' performance in General Physics. According to Abubakar (2020), Ebora (2016), and Pullicino and Bonello (2020), a learning module should emphasize embedding skills and knowledge in holistic and realistic contexts. Anchored contexts support complex and ill-structured problems wherein learners generate new knowledge and sub-problems to determine how and when the command is used.

**Table 12:** Summary of the Acceptability of the Learning Modules in General Physics 1.

| Variables | Mean | SD | Verbal Interpretation | Rank |
|---|---|---|---|---|
| Objectives | 4.00 | 2.14 | Highly Acceptable | 8 |
| Learning Content | 4.20 | 2.17 | Highly Acceptable | 4 |
| Application | 4.05 | 2.17 | Highly Acceptable | 6 |
| Evaluation | 4.03 | 2.15 | Highly Acceptable | 7 |
| Clarity | 4.15 | 2.06 | Highly Acceptable | 5 |
| Presentation | 4.55 | 2.15 | Very Highly Acceptable | 2 |
| Navigation | 4.43 | 1.92 | Highly Acceptable | 3 |
| Usefulness | 4.70 | 2.30 | Very Highly Acceptable | 1 |
| **Over-all Weighted Mean** | **4.26** | **2.14** | **Highly Acceptable** | |

Table 12 revealed the overall acceptability of the developed learning modules in General Physics 1 as assessed by the faculty members of the Mathematics and Science Department of Quezon City University. Respondents agreed that the overall acceptability of the learning modules in General Physics 1 is "Highly Acceptable," with a computed overall weighted mean value of 2.14 and standard deviation of 2.14.

Results showed that the developed learning modules are ready for utilization by the Grade 12 Senior High School students under the Science, Technology, Engineering, and Mathematics strand. According to the respondents, the developed learning modules for General Physics 1 are "Very Highly Acceptable" in terms of their usefulness (M=4.70; SD=2.30) and presentation (Mean=4.55; SD=2.15). And "Highly Acceptable" in terms of navigation (M=4.43; SD=1.92), learning content (M=4.20; SD=2.17), clarity (M=4.15; SD=2.06), application (M=4.05; SD=2.17), evaluation (M=4.03; SD=2.15), and learning objectives (M=4.00; SD=2.14).

## 4. Conclusions

The study aimed to develop learning modules for the subject General Physics 1 based on students' academic performance in a diagnostic test and validate its learning objectives, learning content, application, evaluation, clarity, presentation, navigation, and usefulness. The following sub-sections discussed the results of the study.

Based on the results, the performance of the students in the diagnostic test for the subject General Physics 1 is satisfactory, and their prior knowledge on the subject is somewhat relatively poor, as revealed by the mean score of the test.

STEM students' least mastered skills include scientific and mathematical competencies such as computing, graphing, and interpreting among topics such as kinematics, work, energy, and energy conservation, the center of mass, momentum, impulse, and collisions, temperature and heat, ideal gases, and the Laws of Thermodynamics.

Learning modules for General Physics 1 are developed based on the diagnostic test results and the least mastered

skills of the Grade 12 STEM Senior High School students in General Physics 1. The developed learning modules follow the Curriculum Guide for the subject General Physics 1 set by the Department of Education. It contains the following essential features: (1) Learning through Diagrams; (2) Unit Opener; (3) Summarizing Your Ideas; (4) Process Skills Worksheet; (5) Learning Banks. Time-tested Activities; (6) Online Search; (7) Note box; and (8) Rubric Guides.

The overall acceptability of the developed learning modules in General Physics 1 is highly acceptable. Regarding the modules' presentation and usefulness, the developed learning modules are very highly acceptable. In addition, respondents said that it was highly acceptable in terms of learning objectives, learning content, application, evaluation, clarity, and navigation.

Based on the findings and conclusions of the study, the researcher suggests utilizing the developed learning modules for General Physics 1 to increase the level of performance of Grade 12 Senior High School students under the Science, Technology, Engineering, and Mathematics (STEM) strand and to supplement and augment the delivery of teaching during the pandemic. Science teachers may study the effects of the developed learning modules on the students' attitudes towards learning the subject matter and identify the strengths and weaknesses of the developed learning modules by utilizing them in an actual classroom setting. Lastly, for school administrators, it is suggested to provide training and seminars to faculty members on how to develop learning materials for Physics and other science subjects suitable for senior high school students during the pandemic that will suffice their needs.

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