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Development, validation, and use of module for the Science 10 learning competencies needing mastery

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Abstract

This study aimed to develop, validate, and use a module for the learning competencies in Science 10 that need mastery. This paper consists of three phases. First is the development of the module; second is the validation of the developed module; and last is the use of the developed and validated module. The first two phases employed the research and development method, which aimed to produce and validate educational products. However, a randomized controlled trial was employed to determine the module's effectiveness. Results revealed that this module obtained a very high level of acceptability in content, language, intellectual property compliance, and illustrations, with a mean of 3.82, 3.84, 3.72, and 3.83, respectively. Further, there is a highly significant difference in the mean post-test scores between the control and experimental groups. This is reflected in the t-value of -7.689, which is significant at the .000 level. The results suggest a remarkable improvement in the scores of the experimental group in the post-test. This proves that after employing the intervention, the students from the experimental group showed a significant increase in their post-test scores. Therefore, the developed, validated, and used piece in this study is recommended as an intervention material to master the identified least mastered learning competencies used in this study. Further, evidence-based PPAPs (Programs, Projects, Activities, and Policies) that are relative and relevant to this kind of intervention material shall be implemented in science subjects and other learning areas.

Keywords: development of module, intervention material, learning competencies, learning mastery, experimental research

Development, validation, and use of module for the Science 10 learning competencies needing mastery

1. Introduction

The phrase "to ensure inclusive and equitable quality education and promote lifelong learning opportunities for all" sums up a deep dedication to creating a society in which everyone, regardless of background, identity, or circumstance, has the inherent right to an education. One of the top Sustainable Development Goals (SDGs) of the United Nations is this all-encompassing vision, with the main objective being to transform the world so that no one is left behind (Goal 4: Quality Education - the Global Goals, 2024) (Marco, 2018). In its unwavering commitment to advance the global goal of inclusive and equitable quality education, the Department of Education of the Philippines has introduced the transformative MATATAG Agenda. This strategic initiative, which is represented by the acronym MATATAG, aims to empower learners worldwide and revolutionize educational systems through a multifaceted approach. The department's commitment to developing a curriculum that crosses conventional boundaries is highlighted by the first pillar of this agenda, "MA," which guarantees the curriculum's relevance in preparing students for success in the dynamic workforce as well as academic success. The Department of Education works to develop responsible, involved, and active citizens who are prepared to make significant contributions to society by coordinating educational content with real-world needs. Regarding the second pillar, "TA," the agenda presents a proactive approach to expediting the provision of fundamental education services and facilities (DepEd, 2023). Recognizing the urgency of accessible education, this element reflects a commitment to bridging gaps in educational infrastructure, ensuring that every learner has access to the necessary resources for a comprehensive and enriching learning experience.

Once more taking a comprehensive approach, the third pillar, "TA," emphasizes the value of inclusive education, learner well-being, and creating a positive learning environment. Finally, the "G" in MATATAG stands for the department's commitment to offering teachers unwavering support. The Department of Education hopes to improve the general quality of education by funding teacher development so that educators can support students in having successful learning experiences. The MATATAG Agenda is a progressive plan that calls for a thorough overhaul of the educational system. The Department of Education hopes that this initiative will not only produce intellectually gifted people but also raise a generation of resilient, compassionate, and empowered citizens who are prepared to face the challenges of an ever-changing global environment. The department's commitment to ensuring that education catalyzes positive change and societal advancement is demonstrated by this agenda (DepEd, 2023). In connection with this, the SabNaHiS, formulated and implemented different programs, projects, and activities to support the above mandate and address the learning losses and gaps. Thus, all departments proposed plans anchored in the school's Project SabNaHiS (School Activities Brought by Needs Assessment: Holistic and Interconnected Stakeholders) that shall be implemented to design, develop, implement, and evaluate appropriate school intervention activities (projects and programs) brought by needs assessment to uphold holistic and interconnected stakeholders (School Based Management, 2022).

Working on the said premise, the Science department initiated the implementation of Project Student Academic Achievement at Reach (StAaR). The main objective of this project is to increase the academic performance of students in science. To contribute to the objective of this project, teachers are tasked with developing, validating, and using learning resources that can be used as intervention or remediation material on the identified learning competencies in science needing mastery (SabNaHiS -Science Department, 2020). Since the proponent of this study is one of the science teachers, she is motivated to contribute to this common goal of the department and the school. Therefore, to respond to the mandates and policies of the Department, and to contribute to Sustainable Development Goal No. 4 of the United Nations, the researcher, with a mission to deliver quality education for all, conducted this study on the development, validation, and use of modules for the

Science 10 learning competencies needing mastery. Further, the action taken from this study is also a response to one of the objectives of the 1987 Constitution of the Republic of the Philippines, Article IV, Section 1, which states that teachers are legally tasked with providing learner-centered, inclusive, responsive, relevant, and contextualized K–12 basic education (DepEd, 2015). This innovation and intervention strategy through the modular form is hoped to retort to the pressing need for basic education in the Philippines.

Statement of the Problem - The main purpose of this study was to develop, validate, and use the module for the Science 10 learning competencies needing mastery. Specifically, this study sought to answer the following questions: (1) What are the identified learning competencies needing mastery for Science 10 based on the results of summative assessments? (2) What is the level of acceptability of the developed module for the least mastered learning competencies in grade 10 science in terms of content, language, intellectual property rights compliance, and illustrations? (3) What is the assessment of the quality of test items in the module for the least mastered competencies in grade 10 science? (4) What improvements can be made in a module based on the rating given by the teacher-validators before its actual utilization? (5) What is the level of performance of selected grade 10 students in the learning competencies needing mastery of the developed and validated module in science in their pre-test scores? (6) What is the level of performance of selected grade 10 students in the learning competencies needing mastery of the developed and validated module in science in their post-test scores? (7) Is there a significant difference between the pre-test and post-test scores of selected grade 10 students in the learning competencies needing mastery?

Significance of the Study - The findings of the study are beneficial to the following: For the teachers, the findings of this study can help them identify the skills or knowledge content that needs to be emphasized or strengthened. They will become more effective in teaching science by using the developed and validated module in this study as intervention material, which is especially designed for the needs of the students in understanding the multifaceted learning competency. Thus, the goal of education, such as quality, excellence, and dynamic lifelong learning, will become more possible and productive. For the students, the modified supplementary intervention material may help them better understand sets of learning competencies which are difficult for them to achieve. Also, they will tend to discover their strengths and capabilities to develop their own techniques in understanding the concepts in Science 10 using the validated module as intervention material. For the school heads, the results of this study can serve as their basis and guidelines in developing and implementing policies, programs, projects, and activities (PPAPs) that can improve the academic performance of students in science. For the education program supervisor, the results of this study will support the goals and objectives of the Division Education Development Plan (DEDP) of Science in terms of providing intervention material that can increase the academic rating/performance of Mindoreño learners in the field of science. For the curriculum planners, the result of this study is relevant to the curriculum planners, who will design functional curricula by taking into consideration the needs and preferences of the students and teachers. Furthermore, the findings of the study equally help alleviate the problem of the scarcity of instructional materials. For the Department of Science and Technology-Occidental Mindoro Provincial Office, the result of this study is beneficial to the DOST personnel, who will provide and plan various programs and activities and advance instructional materials to improve the level of performance of students and teachers in science education. The result of this study is relevant to the parents, who will serve as active key players in their children's learning by assisting with module-related activities, and assessments, and fostering a collaborative educational environment at home. The findings of this study are beneficial to the Local Government Unit, which will implement different national educational schemes or policies at the local level. This information helps in making informed decisions, identifying areas for improvement, and implementing targeted interventions to enhance the quality of education in the local community. For the Congressional Commission on Education (EDCOM), the findings of this study support the primary goal of this sector, which is to make the Philippine education system more competitive, responsive, equitable, efficient, and effective in the next three years, from 2023 to 2026. The findings of the study give importance to future researchers who are also interested in modifying instructional materials for the improvement of other least mastered learning competencies across and within learning areas by providing them

with the facts needed for their study. Furthermore, this paper served as a theoretical model for future studies of the same nature if the existing problem that has penetrated in this case will exist in the future.

Scope and Delimitation of the Study - This study focused on the development, validation, and use of modules for the least mastered learning competencies in grade 10 science. Specifically, it concentrated on the (1) identified learning competencies needing mastery in every quarter in grade 10 science based on the results of summative assessments, (2) what module can be formulated based on content, intellectual property rights compliance, language, and illustrations, (3) rating of the teacher-respondents on the developed module in terms of content, intellectual property rights compliance, language, and illustrations (4) improvements can be done based on the rating given by the teacher-evaluators/validators, (5) level of performance of grade 10 students in the least mastered learning competencies in terms of pre-test and post-test scores, (6) significant difference on the performance of grade 10 students on the learning competencies needing mastery in science. The development and validation of the module were done in the school year 2019-2020, however, due to the occurrence of the COVID-19 Pandemic, it was hard to ensure the validity of results in terms of the use of the module, thus, this module was used in last school year 2022-2023 to determine its effectiveness. To note, only the identified learning competencies needing mastery for school year 2022-2023 were used to determine the effectiveness of the developed and validated module, and to make this study relevant to this time. Since, there were items in the test questions which were rejected, and needed revision based on the results of item analysis, they were removed from the current test and recomputed the scores of the students and removed from the pool of items for future tests. But for this study, these items were used in the administration of the pre-test and post-test.

2. Methodology

Research Design - This study underwent three major phases, such as the development, validation, and use of the module. The first two phases used the research and development method. This research design was coined by Borg and Gail in 1983 and primarily aimed to produce and validate educational products. However, in terms of the use of the developed and validated module, a randomized controlled trial (RCT) design was utilized. This type of experimental research design involves randomly assigning participants to either an experimental group or a control group. The control group does not receive the intervention or treatment under test, the experimental group does. The purpose of this design is to compare the outcomes of the two groups to determine the effectiveness of the intervention or treatment. The key feature of an RCT design is random assignment, which helps to ensure that the two groups are equivalent at the outset of the study. This helps to control for extraneous variables that may affect the outcome of the study. The use of a control group also helps to control for these variables by providing a baseline against which the experimental group can be compared.

Participants of the Study - The study involved three groups of participants. The first group of participants was composed of 30 randomly selected teachers who served as the validators of the module. An informed form was secured before the involvement of the participants. These teachers were given a copy of the module and a survey questionnaire checklist to rate the level of acceptability of the module in terms of content, language, intellectual property compliance, and illustrations. The second group of participants were expert validators and members of the LRMDS (Learning Resource Management and Development System) quality assurance team to cross-validate the quality of the developed module. These validators included three content experts and one expert on each criterion, such as language, intellectual property compliance, and illustrations. The third group of participants were the selected grade 10 students from the two sections of SabNaHiS enrolled in the school year 2022-2023. The experimental group was composed of 45 students, who used the developed and validated module to determine its effectiveness as intervention material. However, 45 students also served as participants in the control group. They were the students who did not use the module as intervention material, but a traditional lecture-discussion strategy was used. These ninety students were enrolled in Sablayan National Comprehensive High School, in the school year 2022-2023. A complete enumeration was used in the study, however, to ensure that the two groups, experimental and control, had an equal number of students, random sampling was employed.

Research Instrument - The researcher utilized an adapted questionnaire from the DepEd materials issued in 2019 by Lucero (2020), that was changed to collect the data needed for the validation of the module. The 15-item pre-test and post-test for each learning competency from the first quarter to the fourth quarter, with a total of 60 items, were crafted to determine the mastery level of students on the identified least mastered learning competencies in science 10 from the first quarter to the fourth quarter. The test was subjected to content and construct validity tests done by the experts. To note, the pre-test and post-test have the same content of test questions because the researcher used the test-retest method. The researcher employed the teacher-participants validation checklist of the module to determine its level of acceptability in terms of content, language, intellectual property compliance, and illustrations. The prerequisites for creating a legitimate data collection instrument were considered when preparing the instrument, and modifications, and revisions were made to make the present study parallel to the current curriculum content and performance standards of the assessed least mastered learning competencies in grade 10 science. The indicators of the instrument were aligned with the Alternative Delivery Mode learning resource standards of the Department of Education issued in 2019. To produce a quality-assured module on this study, the content editor, language editor, IPR/Social content reviewers, and layout Artist/Technical reviewer of the Learning Resource Management and Development System, or LRMDS, team of evaluators cross-validated the developed module.

Four external experts validated the survey questionnaire. Following the retrieval, the researcher discussed the expert recommendations and incorporated them into the instruments' second iteration. The research instrument was sent again to experts for final validation. Further, to attain the content validity of the test-retest research instrument (pre-test & post-test) the researcher asked for technical assistance from the three experts in different fields.

Table 1

Validity of Evaluation Checklist on the Module for the Least Mastered Learning Competencies in Grade 10

Indicator	Mean	Interpretation
Content	3.82	Very High
Language	3.84	Very High
Intellectual Property Compliance	3.72	Very High
Illustrations	3.83	Very High

Legend: 3.25-4.00- Very High; 2.50-3.24-High; 1.75-2.49-Low; 1.00-1.74-Least

To assess the reliability of the survey instrument for teacher-validators, Cronbach's alpha was computed to measure the internal consistency. For test-retest research instrument, this study used test questions, which are all multiple-choice type of tests that assess whether the answers of the students are right or wrong, therefore, Kuder-Richardson (KR) 20 is to be used by the researchers to determine the consistency of test results or the instrument itself in general. Reliability refers to how consistent the results from the test are, or how well the test is measuring what you want it to measure. The KR-20 is used for items that have varying difficulty. After having checked the 15-item science quiz, scores were recorded as one for a correct answer and zero for an incorrect answer. Scores were obtained from the first quarter period to the fourth quarter period. The reliability of the instrument was then assessed using the Kuder-Richardson Formula 20 (KR-20). The KR-20 measures the reliability of a test with binary variables and is used for items that have varying difficulty since some items were easy and some were more challenging

Table 2

Result of Reliability Analysis

Components	Number of items	Reliability Coefficient*	Interpretation
Test Questionnaire	60	0.91	Very High

*Cronbach's Alpha based on standardized items

The computed KR-20 coefficient for the whole test reached 0.91 which denotes a very high reliability so the test can be administered to the final group of respondents.

Data Gathering Procedure - The adapted questionnaires were distributed to the respondents after receiving consent from the school principal to conduct the study. The researcher personally delivered the instruments to the respondents in their respective areas. After a week, the survey questionnaires were collected from the respondents. Computer software was used to count, process, analyze, and interpret the data. Ten randomly selected participants from the respondents were gathered for the conduct of a focus group discussion (FGD) to cross-validate and support their responses through thematic analysis on the improvements that can be made in the module. There was one guide question asked to the participants, and each of them was given enough time to answer in a round order of sharing their insights. After a week, the transcription of the FGD-coded themes, and thematic analysis by factor were presented to the same group of participants and asked for their approval on the authenticity of the data. After the developed modules are validated, permission to use them is sought from the Office of the Principal and Grade Level Coordinator of the target student-participants. After which, the developed and validated module was used by grade 10 students during the scheduled day and time of the discussion of the topic. Lastly, after the discussion through a modular form, post-tests were administered, and the results of the tests were retrieved, tallied, computer-processed, analyzed, and interpreted. Moreover, the interview guide question was also used with only one question to support and cross-validate the responses of the participants from the survey questionnaire. The question used in the Focus Group Discussion (FGD) is research question number 4 in this study, which is "What are the improvements that can be made in the module in terms of content, language, intellectual property compliance, and illustrations?" The learning competencies included in the module that were developed were based on the results of summative assessments conducted and their MPS results in grade 10 science. The results of these assessments were encoded, tallied, and processed using the item analysis software.

Statistical Treatment of the Data - In the item analysis of the test items covered in the module for the least mastered learning competencies in grade 10 science, a set of formulae (Nobis, 2021) is used. The index of difficulty is computed using: Item difficulty = (Ph + Pl)/2 ; where: pH = total correct response in the high-scoring group/N per group and pL = total correct response in the low-scoring group/N per group. The index of discrimination is calculated using: Item discrimination = pH – pL. To interpret the difficulty and discrimination indices, the following ranges are presented.

Table 3

Range of Difficulty and Discrimination Index of Test Items

Difficulty Index	Interpretation
0.76 or higher	Easy
0.25 – 0.75	Average
0.24 or lower	Difficult
Discrimination Index	Interpretation
0.40 and above	Very Good Item
0.30 – 0.39	Good Item
0.20 – 0.29	Reasonably Good Item
0.10 – 0.19	Marginal Item
Below 0.10	Poor Item

Table 3 shows the range of difficulty and discrimination index of test items. It involves the numerical scale for the difficulty index and their verbal descriptions. A difficulty index of 0.76 or higher is interpreted as easy; 0.25 to 0.75 is average; and 0.24 lower is interpreted as difficult. Moreover, the difficulty index from 0.40 and above is interpreted as very good item; 0.30 to 0.39 as a good item; 0.20 to 0.29 as a reasonably good item; 0.10 to 0.19 as the marginal item; and below 0.10 as a poor item. The cross tabulation of the difficulty index and discrimination index of the items is presented below to judge whether an item is to be retained, revised, or

rejected.

Table 4

Item Analysis Matrix

DIFFICULTY LEVEL/INDEX	DISCRIMINATION LEVEL/INDEX				
	VERY GOOD ITEM (0.40 and >)	GOOD ITEM (0.30 – 0.39)	REASONABLY GOOD ITEM (0.20 – 0.29)	MARGINAL ITEM (0.10 – 0.19)	POOR ITEM (< 0.10)
DIFFICULT (0.24 or <)	*Revise*	*Revise*	*Revise*	*Revise*	*Reject*
AVERAGE (0.25 – 0.75)	*Retain*	*Retain*	*Retain*	*Revise*	*Reject*
EASY (0.76 or >)	*Revise*	*Revise*	*Revise*	*Revise*	*Reject*

As shown in the table, the only items to be retained are those with average difficulty that are very good, good, or reasonably good in terms of their discrimination power. Items that need revision are the difficult and easy items with marginal, good, good, and very good discrimination indexes. Items to be rejected are those with a poor discrimination index. The mastery level of selected grade 10 students on the least mastered learning competencies of the developed module in science, considering their pre-test and post-test scores, has been described using the frequency and percent distribution. The computation of the weighted means was used to describe the level of acceptability of the developed module for the least mastered learning competencies. To test the differences between the pre-test and post-test scores of selected grade 10 students on the least mastered learning competencies in science, the paired samples t-test was applied in both the pre-test and post-test. The same tool was used to determine the comparability of the experimental group and control group before the intervention was given. All computations were set at the 0.05 significance level. The following indices were used to interpret the instrument's level of acceptability of the evaluation checklist on the module for the least mastered learning competencies in grade 10 science.

Ethical Considerations - A courtesy letter to a school head, a consent letter to the respondents, and a letter for the validity and reliability of research instruments were personally distributed and properly documented. Teacher participants were personally informed of the data asked of them and how they were used in the study. Furthermore, participants were treated with anonymity and confidentiality and were used solely for this research study. An assent letter was also sent to the respondents and to their parents to ensure that they agreed that they would participate in the study. In adherence to the Data Privacy Act, the photo documentation of the respondents was properly kept by the researcher, since it is not advisable to post it on any platforms. To ensure that there was no replication of the study, diligent effort through library searches was made. Other supporting information that was included in the literature review and the adopted and modified survey questionnaire was properly and accurately acknowledged through appropriate citations and bibliographic entries. As to the validation of the responses of the participants during the FGD, their approval of the authenticity of the data was sought, as were coded themes, and thematic analysis by factor.

3. Results and Discussions

Table 5 shows the identified least mastered learning competency in grade 10 science from the first quarter to the fourth quarter. The results of students' assessments were properly encoded, tallied, and interpreted using the item analysis software. The results revealed that one learning competency per quarter needs mastery. Thus, these learning competencies are the basis in crafting the module of this study (School Based Management System-DepEd Order no. 42, s 2017).

Table 5

Identified Learning Competencies Needing Mastery per Quarter

Quarter	Learning Competency	Code
First	Describe and relate the distribution of active volcanoes, earthquake epicenters, and major mountain belts to Plate Tectonic Theory.	S10ES-Ia-ja-36.1
Second	Predict the qualitative characteristics (orientation, type, and magnification) of images formed by plane and curved mirrors.	S10FE-IIg-50
Third	Explain how protein is made using information from DNA.	S10LT-IIId-37
Fourth	Investigate the relationship between volume and temperature at the constant pressure of a gas.	S9MT-IIj-20

Table 6 presents the rating of the respondents on the level of acceptability of the module in terms of its content, language, intellectual property compliance, and illustrations. The results show that it obtains a composite mean of 3.82 and is interpreted as very high. Therefore, it implies that, in terms of content, the developed and validated module from this study is aligned with the specific learning competency. The findings of this study were supported by Mijares (2023), who emphasized, the importance of alignment in enhancing student learning, and described a step-by-step process for developing modules that are well-aligned with learning objectives. Another related study stating that content is very important to the development of a module is the study of Sahoo & Mishra (2020). They found that high-quality content significantly improved student engagement and learning outcomes. In terms of the level of acceptability of the module in language.. The results show that it obtained a composite mean of 3.72, which is interpreted as very high. Therefore, it implies that the developed and validated module from this study was anchored on the ADM-LR guidelines, which is suited to the target users of the module. Further, the results of this study are like the findings of Prain (2004), who found) that language plays a critical role in the learning of science and that it should be carefully integrated into the design of science modules. Thus, to consider this barrier, the use of simple language in the developed learning activity must be taken into consideration. The material includes the use of the everyday language of the learner with an appropriate vocabulary. With this, the lessons will be more interesting, easy to understand by the learners, and enable teachers to easily express concepts.

Moreover, the teacher-validators' rating in the module in terms of intellectual property compliance gained a composite mean of 3.84, described as very high. This implies that the module that was developed and validated in this study passed the intellectual property compliance. The findings of this study are justified by the World Intellectual Property Organization (WIPO, 2023) emphasizing the importance of IP compliance in creating innovative educational materials. The study found that IP compliance encourages creativity and innovation in the development of educational materials, which leads to better educational outcomes for students. It also ensures that the creators of educational materials receive fair compensation for their work, which incentivizes them to continue creating innovative materials. Lastly, the teacher-validators' rating in terms of illustrations in the developed module of this study obtained a composite mean of 3.83, described as very high. This implies that the illustrations used were suited to supplement the text in the module. The result of this study is anchored in the ADM-LR Guidelines of DepEd which is appropriateness on age, grade level and context of the Grade 10 learners (DepEd, 2019).

Table 6

Mean Level of Acceptability of the Developed Module for the Least Mastered Learning Competencies in Grade 10 Science in terms of Content, Language, Intellectual property compliance and Illustrations

Indicators (Content)	Weighted Mean	Interpretation
1. The content is aligned to the content standards, learning competencies, and performance tasks issued by the Department of Education.	3.80	Very High
2. The content is properly and comprehensively developed.	3.77	Very High

3.The sequence of the contents and activities facilitates the achievement of objectives.	3.87	Very High
4. The content is logically arranged from simple to complex, from observable to abstract.	3.77	Very High
5. The activities/exercises in each lesson develop the learners' ability to learn the subject independently.	3.70	Very High
7. The content depicts the ethnic, physical, mental, religious, cultural, and socio-economic diversities of learners and their circumstances in society and promote sensitivity to and respect for the dignity and equal treatment of all.	3.87	Very High
8. The content is free from any social content violations.	3.83	Very High
Composite Mean	3.82	Very High
Indicators (Language)		
1. The material used an appropriate language and vocabulary.	3.70	Very High
2. The length of the sentences and paragraphs are age-appropriate.	3.70	Very High
3.Conjunctions and transitional phrases are used to link sentences or paragraphs.	3.67	Very High
4.Vocabulary level is adapted to target users' experience and understanding.	3.73	Very High
5. There is a logical and smooth flow of ideas within a lesson and from lesson to lesson.	3.87	Very High
6. There is a consistently good use of transition devices to focus on the main topics and signal a change of topic.	3.73	Very High
7. Lessons, instructions, exercises, questions, and activities are clear to the target user.	3.67	Very High
Composite Mean	3.72	Very High
Indicators (Intellectual Property Compliance)		
1. The learning resource has no copyright violations.	3.93	Very High
2. The copyrighted texts and visuals used in the module are cited.	3.80	Very High
3. The references are properly cited in the bibliography.	3.80	Very High
Composite Mean	3.84	Very High
Indicators (Illustrations)		
1. Supplement the text.	3.80	Very High
2. Clarify the concept/topic and facilitate comprehension.	4.00	Very High
3. Illustrations and visuals shall be gender and culture sensitive.	3.70	Very High
4. Illustrations and visuals shall sustain consistency of style, color, size, and angle throughout the manuscript.	3.87	Very High
5. Illustrations and visuals shall be properly labelled and captioned.	4.00	Very High
6. Illustrations show harmonious blending of elements.	3.77	Very High
7. Illustrations used are appropriate to the learner's cultural background and adhere to the social content guidelines.	3.73	Very High
8. Artistically appealing, simple, and easily recognizable.	3.73	Very High
Composite Mean	3.83	Very High

Scale: 3.25-4.00- Very High; 2.50-3.24-High; 1.75-2.49-Low; 1.00-1.74-Least

Table 7 presents the item analysis matrix for the grade 10 science examination on the learning competencies that needs mastery for the control group. The table shows that no test items are difficult with a difficulty level of 0.24 or <. However in an average with a difficulty level from 0.25 to 0.75, six items such as item numbers 4, 27, 31, 38, 44, and 50 were reflected to be very good item (0.40 and >); five items were reflected as good items (0.30 – 0.39) such as item numbers 29, 32, 40, 51, and 53; six items were reflected as reasonably good items (0.20 – 0.29) such as item numbers 2, 7, 36, 43, 55, and 60; eleven items were reflected as marginal items (0.10 – 0.19) such as 3, 18, 19, 20, 22, 26, 35, 46, 47, 48, and 49; and twelve items such as 21, 23, 24, 25, 34, 39, 45, 54, 56, 57, 58, and 59 were reflected as poor items (< 0.10). On the other hand, there are easy items with a

difficulty level of 0.76 or >. Item numbers such as 12, 33, and 52 were reflected as very good items (0.40 and >); item numbers such as 14 and 17 were reflected to be good items (0.30 – 0.39); item numbers such as 5,6,8,9,16, 30, and 37 were reflected to be reasonably good items (0.20 – 0.29); only item number 18 was reflected to be a marginal item (0.10 – 0.19); and item numbers such as 1, 10, 11, 13, 15, 41, and 42 were reflected as poor items (< 0.10). In addition, the item analysis matrix for grade 10 science examination on the learning competencies that needs mastery for the experimental group. The table shows that no test items belong to the difficult level. However in average level, 10 items such as numbers 1, 4, 6, 16, 20, 23, 25, 36, 39, and 53 were considered to be as very good item (0.40 and >); five items were considered to be good items (0.30 – 0.39) such as item numbers 27, 35, 38, 45, and 54, five items were considered to be reasonably good items (0.20 – 0.29) the item numbers 5, 21, 34, 49, and 51, 6 items were reflected to be marginal items (0.10 – 0.19) the item numbers 8, 10, 14, 15, 30, and 31 and 13 items such as 2, 7, 11, 18, 19, 28, 29, 32,44, 47, 50, 59, and 60 were reflected to be poor items (< 0.10). On the other hand, there are easy items with a difficulty level of 0.76 or >. Item numbers 37 and 52 were reflected to be very good item (0.40 and >); item number 40 was reflected to be good item (0.30 – 0.39); item number such as 9,13,41,and 46 were reflected to be reasonably good items (0.20 – 0.29); item numbers 22,48,55, and 56 were reflected to be marginal item (0.10 – 0.19); and item numbers,12,24,26, 33,42,43,57, and 58 were reflected to be poor items (< 0.10). As shown in the table, out of 60 items in the experimental group, there are 20 items to be retained with 33.3%; there are 17 items to be revised with 28.3%; and there are 23 items to be rejected with 38.4%. While in the control group, there are 17 items to be retained with 28.3%; there are 24 items to be revised with 40%; and there are 19 items to be rejected with 31.7%.

Table 7

Item Analysis Matrix for Grade 10 Science Examination on the Learning Competencies Needing Mastery for Control and Experimental Group

Difficulty Level	Discrimination Level (Control Group)				
	Very good item (0.40 and >)	Good Item (0.30 – 0.39)	Reasonably good item (0.20 – 0.29)	Marginal item (0.10 – 0.19)	Poor Item (< 0.10)
DIFFICULT (0.24 or <)					
AVERAGE (0.25 – 0.75)	4,27,31,38, 44,50	29,32,40,51, 53	2,7,36,43, 55,60	3,18,19,20, 22,26,35,46, 47,48,49	21,23,24,25, 34,39,45,54, 56,57,58,59
EASY (0.76 or >)	12,33,52	14,17	5,6,8,9,16, 30,37	28	1,10,11,13, 15,41,42
Difficulty Level	Discrimination Level (Experimental Group)				
	VERY GOOD ITEM (0.40 and >)	GOOD ITEM (0.30 – 0.39)	REASONABLY GOOD ITEM (0.20 – 0.29)	MARGINAL ITEM (0.10 – 0.19)	POOR ITEM (< 0.10)
DIFFICULT (0.24 or <)					
AVERAGE (0.25 – 0.75)	1,4,6,16,20,23 25,36,39,53	27,35,38,45, 54	5,21,34,49, 51	8,10,14,15, 30,31	2,7,11,18,19, 28,29,32,44, 47,50,59,60
EASY (0.76 or >)	37,52	40	9,13,41,46	22,48,55,56	3,12,24,26, 33,42,43,57, 58

It can be gleaned from the table that the majority of the student-respondents in the experimental group (82.2%) obtained the pre-test scores within the score bracket of 41-50, 13.3% of them got the scores within the score bracket of 31-40, 4.4% of them acquired the pre-test scores within the score bracket of 51-60, and none of

them (0%) obtained the pre-test scores within 21-30. The experimental group which consists of 45 Grade 10 students, obtained a weighted mean of 44.76 in terms of their pre-test scores. However, in the same table, it is revealed that the majority of the student-respondents from the control group (.7%) got scores within the score bracket of 41-50, 6.7% of them obtained the pre-test scores within the score bracket of 31-40, which is also the same with the percentage of students (6.7%) who acquired the pre-test scores within the score bracket of 51-60. None of them (0%) got the pre-test scores within the score bracket of 21-30. The control group, which consists of 45 grade 10 students, obtained a weighted mean of 45.82 in terms of their pre-test scores. It only implies that the random assignment of student respondents to the groups was successful, as the groups were made equal before the intervention. This is a positive aspect of experimental design, ensuring that groups are comparable. The result of this study is supported by the study by Usman et al. (2019), who found that there is no difference in student learning outcomes between the class of control and the class of experiment, where the class of experiment showed higher results than the class of control. Further, since it is evident from the results of the study that the students can work independently to accomplish different learning tasks in the module, the findings of this study are anchored on the theory of individualizing instruction through modules.

Table 8

Thematic Analysis by Factor on the Improvements that can be made to a Module based on the Rating given by the Teacher-validators

Indicator	Quarter	Remarks
Content	1st	Definition of terms and key concepts should be added to the discussion.
	2nd	Incorporate problem-based scenario.
	3rd	Incorporate all the processes that explain how protein is made from DNA.
	4th	Use real-life scenarios to further investigate the relationship of volume and temperature of a gas at constant pressure.
Language	1st to 4th	slight error on grammatical arrangement and misspelled words.
Intellectual Property Compliance	1st to 4th	Incomplete references and citations.
Illustrations	1st to 4th	Proper labelling and captioning of different illustrations

Table 8 presents the improvements that can be done to the module based on the rating given by the teacher-validators. It is very important that a developed module will become effective in which content, language, layout, and deign are also considered in making such module. First indicator is the content, this statement was justified by the findings of Mijares (2023), the importance of alignment of all the contents of the module in enhancing student learning and describe a step-by-step process for developing modules that are well-aligned with learning objectives. Further, it is stated on the paper of Barthakur et al. (2020), aligning learning objectives, activities, and assessment to the design of modular online courses is important. The authors argue that alignment is critical to ensuring that students achieve the intended learning outcomes, and that the module is effective. However, Oguledo (2023) highlighted in their study that if the content is not aligned to the learning objectives, this can lead to confusion and poor learning outcomes for the students. Second, the role of language in the development of instructional materials is important. This statement was supported by Prain (2004) that language plays a critical role in the learning of science and that it should be carefully integrated into the design of science modules. Thus, to consider this barrier, the use of simple language in the developed learning activity sheets must be put into consideration. The material includes the use of the everyday language of the learner with an appropriate vocabulary. With this, the lessons will be more interesting, easy to understand by the learners, and enable teachers to easily express concepts (ADM-LR, Lucero, 2019). Third, Intellectual Property (IP) is a crucial

aspect of creating and developing instructional materials. According to a study by the International Association of Scientific, Technical and Medical Publishers (2018), IP compliance is vital for the integrity of scientific research and education. The study found that unauthorized use of copyrighted materials undermines the credibility of scientific research and leads to legal issues that can damage the reputation of the institution. Therefore, IP compliance is essential to ensure the integrity and quality of educational materials. Lastly, the use of illustrations in the module was also based on the ADM-Learning resource standards. The illustrations used help readers to comprehend ideas which are difficult to explain using only a written text (Maa illustrations, 2016). It was also aligned with the Social Content Guidelines, which support the desired values such as nationalism, justice, moral uprightness, inclusion, understanding, and compassion among students. Moreover, it also showed the appropriateness of age, grade level, and context of the grade 10 learners.

Another study that supports the importance of illustrations in education was stated by Lule and Aditi (2022), that picture illustration offers effective visual aids to support learning. Numerous learning objectives, including comprehension, recall, and problem-solving, are improved by illustrations. Diagrams and graphics are examples of illustrations that use appropriate and minimal visual language to help understand vast amounts of data. Students' critical thinking abilities and visual literacy are developed, among many other skills that are sharpened. Therefore, these four components are very important key points to consider in the development of modules. If these four components, pass the quality standards, it means that intervention material in modular form is effective.

Table 9

Paired Samples T-Test on Students' Level of Performance on Science 10 Learning Competencies Needing Mastery on the Developed Module Based on Pre-test and Post-test Scores

(Pre-test)						
GROUP	MEAN	STANDARD DEVIATION	MEAN DIFFERENCE	*t*-VALUE	*p*-VALUE (SIG.)	INTER-PRETATION
Control	45.82	4.092	1.067	1.546	.129	Not Significant
Experimental	44.76	3.650				
(Post-test)						
Control	47.42	5.719	-7.756	-7.689	.000	Highly Significant
Experimental	55.18	2.424				

Table 9 presents the paired samples T-Test on students' level of performance on the learning competencies in science 10 needing mastery on the developed module based on pre-test scores. As shown in the table, the grade 10 learners at Sablayan Comprehensive National High School were assigned to either a control group or an experimental group based on their level of performance in the pre-test scores on the identified learning competencies needing mastery. After the student respondents were grouped, the pre-test was administered to the two groups. This intends to compare the experimental group with the control group based on their level of performance on the least mastered competencies of the developed module in science. With a mean score of 45.82 for the control group and 44.76 for the experimental group in the four quarter periods, the mean difference of 1.067 is considered small. Standard deviations of 4.092 and 3.650 denote small deviations from the mean. The t-value of 1.546 is small and gives a p-value that exceeds the 0.05 level. Thus, it failed to reject the null hypothesis of no significant difference between the control and experimental groups based on their pre-test scores. This indicates no significant difference in their scores before the treatment. It can be derived that the two groups were comparable before the start of the use of the developed module in science. Aside from confirming the comparability of the two groups based on their grades, this also suggests the application of intervention in the science subject. The findings of this study were supported by the study of Nardo & Hufana (2014) that using modules encourages learners to be independent in their studies. Students engage themselves in learning the concepts presented in the module. They develop a sense of responsibility in accomplishing the tasks provided in

the module. With little or no assistance from the teacher, the learners progress on their own. They are learning how to learn; they are empowered.

Based on the post-test scores after employing the intervention, the results of the post-test scores reveal higher mean scores than the pre-test scores for both the control and experimental groups. A mean score of 47.42 was obtained by the control group, while the experimental group got a 55.18 mean score. This reflects a difference of -7.756, highlighting a higher mean score of the experimental group than the control group. Moreover, the dispersion of the scores from the mean, represented by the standard deviation in the control group, which is 5.719, is apparently higher than that of the experimental group, which is only 2.424. This suggests a high level of variability in the control group's mean scores. The students from the experimental group show less variability in their mean scores. A highly significant difference in the mean post-test scores between the two groups is evident. This is reflected in the t-value of -7.689, which is significant at the.000 level. It should be noted that the SPSS program displays a p-value of.000 when the exact computed value is less than.005. The result suggests a remarkable improvement in the scores of the experimental group in the post-test. This proves that after employing the intervention, the students from the experimental group showed significant improvement in their scores. The results of the study were supported by the study of Martiningsih et al. (2019), who also justified that the use of a module can increase the learning outcomes of junior high school students on the science process skills. The same results were also given by the study of Serevina et al. (2019), which found that the development of an e-module based on Problem-Based learning (PBL) on heat and temperature topics could improve students' science process skills.

Table 10

Paired Samples T-Test of the Control and Experimental Groups in Pre-test and Post-test Use of Developed Module in Science

Computed Values	CONTROL		EXPERIMENTAL	
	PRE-TEST	POST-TEST	PRE-TEST	POST-TEST
Mean	45.82	47.42	44.76	55.18
Standard Deviation	4.092	5.719	3.650	2.424
Mean Difference	-1.600		-10.422	
T-VALUE	-3.769		-15.232	
P-VALUE (SIG.)	.000		.000	
Interpretation	Highly Significant		Highly Significant	

The students from the control group disclosed a pre-test mean score of 45.82 and a post-test score of 47.42 giving a difference of -1.600. The mean difference represents the gain score which yielded a t-value of -3.769 and which is held significant at the .000 level. This reflects a considerable improvement in the scores of the control group after an intervention was made. The same holds true for the experimental group which reveals a large mean difference of -10.422 from their pre-test mean score of 44.76 to their post-test mean score of 55.18. The large t-value of -15.232 is highly significant at the .000 level. This proves that after the intervention was applied, the students from the experimental group showed a highly significant improvement in their scores. Overall, it can be said that the developed module was effective in learning science for the grade 10 students. The result of this study is supported by the studies of Highland (2015) about Self-Paced Individualized Learning, students' abilities to learn independently was increased, and Balderas (2016) also cited that a module helps the students develop learning autonomy, ensures satisfactory minimum standards, provides remedial units, upgrades content, enhances competencies of teachers, caters to individual differences in learning, provides learning resources for distance education, and mastery of the subject matter.

Therefore, the provision of teaching materials in terms of modules can be an alternative to meet the learning needs of science. This statement was justified by the study of Sofia et.al., (2020) that the module developed in their study is valid and effective in improving the learning of biotechnology science which means that the use of

this module is recommended to be implemented in the biotechnology learning process. Further, it was anchored on the theory proposed by Jorgensen (2005) in which he affirmed that a theory of instruction demonstrated a comprehensive approach. The four instructional methods – gain attention, present information, provide practice materials, and provide feedback – point toward effective and efficient instructional approaches, regardless of content or context. Moreover, the purpose of this theory is to provide direction in helping people to learn, understand and/or apply a predetermined set of principles, concepts and/or procedures. The theory is designed to be prescriptive and to promote effective, efficient, and appealing instruction.

4. Conclusions

Based on the findings, the following conclusions were drawn. Based on the results of conducted assessments one learning competency every quarter needs to be mastered in grade 10 science. Therefore, these learning competencies served as the bases in the development of the module in this study. The overall level of acceptability of the module in terms of its content, language, intellectual property compliance, and illustrations is very high. Hence, it can be used as an intervention material to increase the performance of grade 10 students on the identified learning competencies needing mastery. The quality of test items in both pre-test and post-test reflects very good, good, reasonably good, marginal, and poor items in both experimental and control groups. Furthermore, there are also items that need to be retained, revised, and rejected. The participants of the focus group discussion provide comments and suggestions for the improvement of the module in terms of its content, language, intellectual property compliance, and illustrations. Therefore, these improvements must be considered before the actual use of the module. The results of pre-test scores in the control group obtained a mean score higher than the results of pre-test scores of the experimental group. It only implies that before the intervention was conducted, the student-respondents for each group are comparable. In terms of post-test scores, results revealed that this experimental group garnered a mean score higher than the control group. This implies that the proposed intervention material through a modular form is effective. There is a significant difference between the pre-test and post-test scores of selected grade 10 students on the least mastered learning competencies in science. This proves that the developed, validated, and used module from this study can really increase the mastery level of students on the identified learning competencies needing mastery.

4.1 Recommendations

Based on the findings and drawn conclusions, the following recommendations are made: It is recommended that the school head (SH), together with the committee on RM&DP may continue to initiate different innovations and interventions to assess the different learning competencies that need mastery so that appropriate intervention material can be developed. The school head (SH), together with the head teacher, master teachers, and science teachers SabNaHiS may religiously put into action or implement the proposed project MalaSCIkit of the Science Department which is included in the School Improvement Plan (SIP) for fiscal years 2022-2025 for every Annual Implementation Plan (AIP) of SabNaHiS. This is to materialize one of the objectives of this which is to develop appropriate intervention materials and strategies to increase the performance of students in all science subjects. In terms of the construction of test questionnaires, the school head (SH), together with the department heads and master teachers of the institution, shall provide continuous technical assistance in crafting competency-based test questions. Since there are improvements in the developed module, the school administration, and the staff together with the school quality assurance team, should openly discuss issues about the required standards in the development of instructional materials during the departmental learning action cell sessions. Further scrutiny and review may also be done by the experts to review the concepts and principles integrated into the module. It is recommended that the proposed intervention from this study which is a modular form can be used by other grade 10 science teachers in their respective science classes having the same learning competencies to further test its effectiveness. Since the study only involved a smaller population (two sections) further study may be done in a larger student population particularly in other sections of grade 10 in SabNaHiS to further assess the effectiveness of the module. To assess whether there is an improvement in the identified

learning competencies needing mastery in Science 10 and if the mastery level of the students is really addressed through a modular form, a 3-year term use of the module on the same learning competencies is recommended. Future researchers may do further studies by using other indicators stipulated in learning resource guidelines in module making which the present study was not able to use.

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