

DEVELOPMENT AND VALIDATION OF A SUPPLEMENTARY LEARNING MATERIAL IN EARTH SCIENCE

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Abstract

The result of the Division Achievement Test in Science administered to Grade 6 learners, out of six competencies included in MELCS, four competencies were identified as the “Least Learned” as they got a mastery level indicated as “Low Proficient”. Thus, this developmental research aimed to develop and test supplementary learning material in the form of interactive modules.

The study was anchored on a Cognitive Theory of Multimedia Learning and the framework for designing instructional solutions to achieve desired learning outcomes. The ADDIE model was used to design and develop the supplementary learning material. The data pertinent to the study were tabulated, analyzed, and interpreted using computing the weighted mean, and each data were provided a descriptive interpretation. Results revealed that learners had developed a positive perception of E-learning. The developed supplementary learning material conforms to the requirements of the Department of Education in terms of Content Quality, Instructional Quality, Technical Quality, and other findings, including conceptual, factual, grammatical, and typographical errors. It was also found to be suitable to serve as an intervention learning material that will help learners achieve the desired learning outcome.

Keywords: Supplementary Learning Material, MELCS, Interactive Modules, E-learning, ADDIE Mode.

Introduction

The educational setting had been disrupted by the COVID-19 pandemic, and this paved the way for the country to shift from face-to-face learning to different alternative learning modalities. To sustain and provide quality education despite the ongoing pandemic crisis, the new normal education was implemented after a series of planning and pilot implementation of different learning modalities. Both teachers and students were forced to adapt to the new way of accessing the body of knowledge as they heavily relied mostly on the use of online resources (Chavez et al., 2020).

Dayagbil et al. (2021) pointed out that due to connectivity limitations, most of the students had difficulty complying with the learning activities and requirements due to limited or no internet connectivity. The concept of flexible learning has emerged as an option for online learning, particularly in educational institutions in the Philippines. DepEd Philippines has used a combination of remote-learning options, including online platforms, educational television and radio, and printed modules. However, social inequalities and a lack of resources at home to support these approaches have impacted many students and teachers (De Guzman, 2021).

Teaching materials played an important role in the

learning process. Adequate learning resources were able to supplement, sustain, and enrich the learning process. Learning materials are currently undergoing development because of technological advancements. The growing development of electronic references that are simple to use and extremely useful has made a significant contribution to the advancement of digital literacy. With the recent implementation of the K-12 curriculum in the Philippines, teachers are being challenged to create a relevant, research-based school curriculum. And responsive instructional materials (Rogayan and Dollete, 2017). Teachers are always looking for ways and means to accomplish things and to make science activities more meaningful to lifelong learning.

Several researchers (Castillo, 2017; Ulah and Anwar, 2020; Estrellan et al., 2021; Taja-on, 2021) have proven that the use of technology and collaborative and interactive activities in groups may positively influence learner engagement. However, barriers to the effective use of interactive instructional materials are still evident in the new normal education. Rotas and Cahapay (2020) revealed the following categories of difficulties in blended learning modality: unstable internet connectivity; insufficient learning resources; power outages; ambiguous learning contents; overloaded lesson activities; limited teacher scaffolds; poor peer

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communication; conflict with home responsibilities; poor learning environment; financial issues; physical health compromises; and mental health struggles. But on the other side of the situation, learners have their coping mechanisms to address these barriers. Learners employed a variety of strategies to overcome the challenges they faced during online distance learning (Barrot et al., 2021). Also, unlike in a traditional classroom setting, the use of interactive instructional materials requires self-motivation and proper time management skills. Learners spend most of their time listening to podcasts, watching videos, and looking at slide presentations as there is no hands-on experience like conducting experiments, lack of social interaction and sometimes not accessible to others (Lynch, 2020).

In line with the DepEd Order No. 018, s.2020 entitled “Policy Guidelines for the Provision of Learning Resources in the Implementation of the Basic Education Learning Continuity Plan. The schools need to ensure that learning opportunities are provided to the learners in a safe manner and through different learning delivery (DepEd, 2020). This research aims to develop a learning module with interactive content to realize the importance of using them as an educational tool in the content, pedagogical, technical, and technological context. The interactive module developed intends to target learners of the sixth grade of intermediate level. The content of the interactive module is outlined on the MELCS or Most Essential Learning Competencies crafted by the Department of Education (DepEd) to be used nationwide by field implementers and private schools for SY 2020-2022. MELCS will allow the department to concentrate instruction on the most important skills that students must learn. It can also lighten the burden of converting classroom-oriented learning resources into distance-learning modalities' learning resources. Furthermore, by providing ample instructional space, the MELCS intends to assist schools in navigating the limited number of school days as they employ multiple delivery schemes.

Based on the result of the Division Achievement Test in Science administered to Grade 6 Learners of Bungahan Elementary School of SY 2020-2021, out of six (6) competencies included in MELCS, four (4) competencies were identified as the “Least Learned” as they got a mastery level indicated as “Low Proficient.” A total of 60.16% was calculated, which represents the mean percentage score of the administered division achievement test in science (Bungahan Elementary School, 2021). These competencies were to (a) describe the changes on the Earth’s surface because of earthquakes and volcanic eruptions which has (b) describe the different seasons in the Philippines, (c) Differentiate between

rotation and revolution, and describe the effects of the Earth’s motions, (d) compares the planets of the solar system. This shows the lack of content mastery of the lessons and indicates an academic underachievement. The DepEd issued Department Order 08 s. 2015 or the Classroom Assessment Policy Guidelines, it implies that there must be sufficient and appropriate instructional interventions to ensure that learners are ready before summative tests and learning intervention must be conducted through remediation and extra lessons for a student who receives a grade below 75 in any subject in any quarter. As a result, no learners will be left behind because appropriate instructions and interventions will be provided to meet individual needs.

The result of the study will surely help the school to increase the academic performance of learners, particularly in the lessons included in Science of Quarter 4. It will also explore how innovation in science education is vital in enhancing the performance of teachers in developing instructional materials as adequate intervention.

Statement of the Problem

The study aimed to develop and validate Interactive Module in Science for Elementary. Specifically, the researcher sought to answer the following questions.

1. What learning objectives, as determined by a needs analysis, could be included in the supplementary learning module?
2. What appropriate design methods could be used to create the supplementary learning module?
3. How valid is the created supplementary learning material in terms of the following categories.
 - 3.1 Factor A: Content Quality
 - 3.2 Factor B: Instructional Quality
 - 3.3 Factor C: Technical Quality
 - 3.4 Factor D: Other Findings (Conceptual Errors, Factual Errors, Grammatical/ Typographical Errors, etc.)
4. Based on the findings of the study, what implications may be drawn?

Scope and Limitations of the Study

This study focused on the development and validation of interactive modules in science. The study was intended for Grade-6 learners, which contains the least learned competencies of Most Essential Learning Competencies (MELCS) of Quarter 4 of science 6. This is based on the needs analysis conducted by the researcher at Bungahan Elementary School.

The developed supplementary learning material in the form of an interactive module underwent a validation process. The evaluation tool for non-print learning materials was adopted from the Learning Resources Management and Development System (LRMDS) of the Department of Education (DepEd).

The validators were comprised of subject matter experts and ICT specialists.

Meanwhile, the interactive module was constructed based on the ADDIE model, which originally consisted of five phases: Analysis, Design, Development, Implementation, and Evaluation. However, in this study, the researcher followed only the first three stages (Analysis, Design, and Development), and the remaining two stages (Implementation and Evaluation) are subject to a recommendation for another research study.

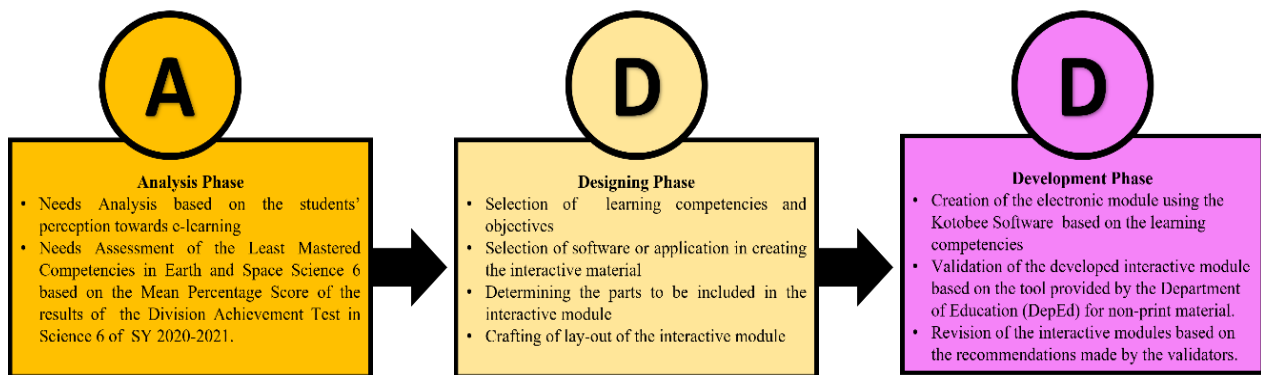
Theoretical Framework

The study is anchored on the E-learning theory called “Cognitive Theory of Multimedia Learning” (CTML), introduced by Mayer in 2003 and cited in a study conducted by Callao (2020). It states that multimedia is defined as an environment in which students access information through text, pictures, sound, animation, video, or a combination of these media. Learning can be made easier by using multimedia materials that include texts, pictures, animations, and videos. It aims to explain the

intellectual processes that take place in learners' minds during meaningful multimedia learning. The theory has clear implications for instructional design to support multimedia learning, particularly in terms of avoiding cognitive overload. Cognitive overload is defined as a situation in which a person is given too much information at once or too many tasks at once, causing them to be unable to perform or process the information as they would if the amount was more manageable.

The theoretical framework serves as the foundation for designing instructional solutions to achieve desired learning outcomes. Multimedia learning theory supports the use of both audio and video that can inform and predict the successful application of multimodal interactive learning environments. The use of e-learning resources such as iPad, tablets, and smartphones which allow learners to can connect to the internet for additional learning resources, improves learning effectiveness as compared to the physical textbook (Ramlatchan, 2019).

Conceptual Framework



The model implies that the researcher aimed to (1) develop a supplementary learning material in the form of the interactive module in Earth and Space-related lessons in Science 6 that is congruent with the “Least Learned Competencies” of the Essential Learning Competencies (MELCS) Science 6-Quarter 4, (2) establish the validity of the learning material using an expert-led validation. To fulfill this goal, the researcher will utilize the ADDIE model in the development of the supplementary learning material in the form of an interactive module. (Figure 1). ADDIE is an acronym for Analysis, Design, Development, Implementation, and Evaluation. This model will walk you through the steps of developing effective educational courses and materials for your target audience (Instructional Design, 2015). It is a type of instructional design model. that has withstood the test of time and application. It is simply a "device" to assist us in thinking through the design of a course. However, the researcher only applied the first three stages (Analysis Phase, Designing Phase, and

Development Phase) because the main purpose of the study is to design and develop supplementary learning material. The remaining two stages (Implementation Phase and Evaluation Phase) are subject to a recommendation for another research study.

Methodology

The descriptive developmental method was used in this study. According to Gillaco (2014), the descriptive-developmental method seeks facts about a current situation. Furthermore, this method focuses on the description, comparison, analysis, and interpretation of existing data. It is developmental in nature as its primary goal was to conduct instructional development, implying that output will be developed following the completion of this research.

The ADDIE model was used in the development and validation of the supplementary learning material. It underwent Analysis, Design, and Development as

both the Implementation and Evaluation stages were subjected to another research study.

a. Analysis phase

In the analysis phase, a needs assessment was conducted to make a review of competencies that will be included in the interactive module. In this stage, the researcher analyzed the result of the

Division Achievement Test in Science administered to Grade 6 Learners of Bungahan Elementary School of SY 2020-2021. Out of six competencies included in MELCS, 4 competencies were identified as the “Least Learned” as they got a mastery level indicated as “Low Proficient.”

Table 1: Learning Competencies of Science 6-Quarter 4 Based on MELCS

Competencies	Code	Mean Score	Percentage	Mastery Level
1. Describe the changes on the Earth’s surface as a result of earthquakes and volcanic eruptions	S6ESIVa1	47 %		Low Proficient
2. Enumerate what to do before, during, and after an earthquake and volcanic eruptions	S6ESIVb2	85 %		Proficient
3. Describe the different seasons in the Philippines	S6ESIVc-3	48 %		Low Proficient
4. Differentiate between rotation and revolution and describe the effects of the Earth’s motions	S6ESIVe-f-5	46 %		Low Proficient
5. Compare the planets of the solar system	S6ES IVg-h-6	49 %		Low Proficient
6. Construct a model of the solar system showing the relative sizes of the planets and their relative distances from the Sun	S6ES IVi-j-7	86 %		Proficient

**Legend: Highly Proficient- 90 %-100 %, Proficient- 75 %-89%, Nearly Proficient- 50%-74%, Low Proficient- 25%-49%, Not Proficient- 0%-24%*

The table above shows the mean percentage score of the Division Achievement Test in Science 6. It shows that out of six competencies included in the Essential Learning Competencies (MELCS), only two competencies got a proficient mastery level. This shows the lack of content mastery of the lessons and indicates academic underachievement. This data was used as a basis for determining the contents to be included in the supplementary learning material. Students’ Perception of E-Learning was also measured using the following indicator: Perceived Usefulness of E-learning, Perceived Self-Efficacy of Using E-learning, Perceived Ease of Use of E-learning, and Behavioral Intention of Using E-learning. These variables were quantified using the following scale; Strongly Agree (5), Agree (4), Neutral (3), Disagree (2), and Strongly Disagree (1). The scale was adopted from the study conducted by Khan et al. (2020) entitled “Students’ Perception towards E-Learning during COVID-19 Pandemic in India: An Empirical Study”. The scale is perfect for the study as it has a validity of coefficient alpha= 0.96. This served as a basis to determine the learning outcomes of the study.

b. Design

Next is the designing phase. For the development of the supplementary learning material in the form of

an interactive module, storyboard preparation and media selection were used. The researcher created a storyboard that includes various items and content that will be displayed on online interactive multimedia at this stage. E-learning media will be used in this interactive multimedia design, which was created with *Kotobee* Author, a digital publishing platform to create and publish interactive eBooks or modules for Android, iPad, iPhone, HTML5, desktop, SCORM, LTI, and more in any format. *Kotobee* is an excellent tool for teachers who want to create digital books and make their classroom content more engaging. The ability to incorporate interactive widgets from sites such as *Bookry* expands your options, and the wide range of publishing options allows you to export your book in any format you require (Karlin, 2017). This software enabled the researcher to construct an interactive module with various features like content integration, gamification, online quizzes, pop-up images, hyperlinks, use of video lessons, etc. Helping authors and educators use interactive elements in their ebooks is what *Kotobee* has always thrived on. *Kotobee*'s mission was to raise awareness of all that ebook technology has to offer, regardless of the industry or genre. A pressing issue in modern digital teaching is the development and implementation of interactive multimedia models in

interactive E-book design to activate learners' personalized learning processes. As cited in the released memorandum by DepEd, in OUA 00-0420-0041, teachers were trained to develop and design an e-book using the Kotobee Author last April 2020. It was a feasible training that covered using OER and Kotobee Author as a tool to support the creation of e-Learning materials composed in epub format and provide effective instruction even without internet connectivity. The participants' output was put through a quality control procedure before being uploaded to DepEd Commons. Participants were given a national digital certificate. As long as they have a free license, educators are free to use the software. Once they do, they are free to use it to create learning materials in the form of eBooks.

The other content included in the interactive module was designed using various software, including PowerPoint to manipulate the objects to be used and as well as Adobe Photoshop to develop images and various contents in the interactive module. Besides, it could be designed independently. The content contained in this multimedia was also obtained from various online sources like Open Educational Resources (OER) and open-licensed videos from YouTube. The developed supplementary learning material was published as (OER), which refers to learning, teaching, and research materials in any format or medium that are in the public domain or are protected by copyright and released under an open license, allowing free access, re-use, re-purpose adaptation, and redistribution by others (UNESCO, 2021).

c. Development Phase

During the development phase, the development of supplementary learning material was carried out by the designed storyboard and topics included in DepEd's Most Essential Learning Competencies (MELCS) in Quarter 4 of Science 6. At this stage, the validation phase was done in two parts; first and second validation. It involved experts in subject matter and information, communication, and technology (ICT). Validation aims to obtain input and improvement of supplementary learning material in the form of an interactive module that has been developed. Improvements to the interactive module were based on written suggestions and direct comments given by validators during the first and second evaluations. The criteria used to validate the material were adopted from the Evaluation Rating Sheet for Non-Print Materials of DepEd-LRMDS.

**Instrument of the Study
Students' Perception of E-Learning**

The researcher used a five-point Likert scale to measure students' perception of E-learning. The instruments used were adopted from the study of Khan et al. entitled "Students' Perception towards E-Learning during COVID-19 Pandemic in India.

This instrument uses a 5-point Likert with responses such as 5-Strongly Agree, 4-Agree, 3-Neutral, 2-Disagree, and 1-Strongly Disagree. The instrument had a Cronbach's alpha value=0.96. The scale was perfect for the study as it was found with excellent content validity

Rating Scale	Descriptive Evaluation
4.50-5.00	Strongly Agree
3.50-4.49	Agree
2.50-3.49	Neutral
1.50-2.49	Disagree
1.0-1.49	Strongly Disagree

Table 2: Evaluation Rating Sheet for Non-Print Materials

The developed module will be evaluated using four (4) factors (Content Quality, Instructional Quality, Technical Quality, and Other Findings, which include conceptual errors, factual errors, grammatical and typographical errors, etc.) and can be interpreted using a scale of 4-Very Satisfactory, 3-Satisfactory, 2-Poor and 1-Not Satisfactory. The researcher will employ purposive sampling to identify validators. There were five (5) selected validators who are experts in the field of subject matter and information, communication, and technology (ICT). This instrument is adopted from the evaluation tool according to the Guidelines and Processes for LRMDS Assessment and Evaluation.

1. To analyze and interpret the data gathered, the following statistical measures were used:

Rating Scale	Descriptive Evaluation
4	Very Satisfactory
3	Satisfactory/Not Applicable
2	Poor
1	Not Satisfactory

The level of validation was quantified using the following scales.

Using the scale above, the developed interactive module must acquire at least 30 points out of a maximum of 40 points to pass the content quality. Same points must be acquired to pass the instructional quality. For technical quality, the resource material must score at least 39 points out of a maximum of 52 points to pass this criterion.

And for Other Findings, the resource must score at least 16 points out of a maximum of 16 points to pass this criterion. If the material fails in at least one of the four Factors in this validation tool, it must

undergo revision and another validation for the specific criterion in which the resource material failed before it can be recommended for possible use

in public schools. The researcher used the scale below for Factor D.

Rating Scale	Descriptive Evaluation
4	Present
3	Present but very minor and must be fixed
2	Present and requires major development
1	Do not evaluate further

Data Gathering Procedure

The researcher obtained written permission from the Division City of Malolos to conduct the study. The researcher developed the supplementary learning material and worked on the instruments needed for the study. After that, the researcher consulted literature, evaluated, and validated the interactive module. The comments and suggestions of the experts were taken into account as the module was improved further. The researcher then proceeded to the analysis and interpretations of the gathered data and concluded the validity of the developed supplementary learning material in the form of an interactive module.

In gathering the data, the research will carry out the following procedures:

1. The LCUP Research Ethics Committee released an endorsement letter to the researcher for the data gathering procedure. This letter was approved by the Graduate School Department and later sent to the office of the Superintendent of the Division City of Malolos, seeking permission to conduct the study.
 2. With the approval of the Schools Division Superintendent and other concerned authorities, the researcher proceeded to the validation of the interactive module.
 3. Next, the researcher asked the help of the validators to evaluate the developed interactive module using the provided tool. After that, the researcher spent time dealing with the revisions of the interactive module.
 4. The researcher tabulated the data gathered and applied a statistical treatment to the data.
1. Data were collected using an adapted survey instrument and analyzed using the Statistical Package for Social Sciences (SPSS) version 25. Descriptive statistics were used to present and analyze the data to describe the perception of students toward E-learning. To determine the perception of students towards E-learning, both mean score and weighted mean were calculated.
 2. Descriptive analysis was applied to develop interactive modules concerning its Content Quality, Instructional Quality, Technical Quality, and Other Findings, which include conceptual errors, factual errors, grammatical and typographical errors, etc.). Five (5) qualified experts in subject matter and expertise in the ICT were chosen to validate the developed interactive module. All aspects provided in the tools must be met, and modifications will be made based on the suggestions and recommendations of the validators.
 3. To test the hypothesis, statistical tests such as;
 - a. Descriptive Analysis was used to describe the process of using statistical techniques to describe or summarize a set of data. It was used to interpret the scores given by the set of teacher-validators in each criterion indicated based on the assessment tool used.
 - b. Inter-rater Reliability Test -The consistency of assessment made by different validators is measured by inter-rater reliability. A high level of inter-rater reliability means that the ratings given by different validators for the same item are consistent.
 - c. Cronbach Alpha Test of Internal Consistency - It is used to assess the reliability or internal consistency among validators.
 - d. Paired t-Test- The Paired Samples t-Test compares the means of two measurements taken from the first and second evaluation results. The tests were used to see if there is

Data Processing and Statistical Treatment

The data collected were tabulated and processed using Statistical Packages with the assistance of a licensed statistician. The data obtained from the results of the validation were analyzed by utilizing the descriptive data analysis procedures. The following steps were followed;

statistical evidence that the mean difference between paired observations is significantly different from zero.

- e. The validation was done in two phases, pre-validation was done to identify some improvements to be done, then followed by post-validation to check whether suggestions for improvements were applied. The material was validated by five teachers who are content and technology experts.

Ethical Compliance

In response to society's expectations of greater accountability, the level of attention on ethical conduct (the actions that are personal, professional, and during research activity) increased and expanded (Zegwaard et al., 2017). The Graduate Studies Department of La Consolacion University Philippines has recently introduced the inclusion of ethical considerations in any thesis and dissertation to ensure that ethical requirements are complied with to protect the dignity and safety of research participants. Hence, the researcher will secure institutional clearances and permission from both LCUP's Graduate Studies Department and the Department of Education's Schools Division Office of the City of Malolos to conduct the study.

The following ethical considerations were put into place for this research undertaking:

1. Before developing the supplementary learning material, the researcher requested a document that would serve as a basis for conducting the study. A letter was sent to the school principal requesting the results of the achievement test from the previous school year, 2020-2021. The dignity and well-being of the validators were protected. They were given informed consent before the validation process. They were not harmed in any form or placed in an uncomfortable position.
2. The researcher sought approval from the school principal and was given informed consent that includes essential information, i.e., who the researcher is, the intent of the

study, the data to be collected, level of commitments, etc. After this, the researcher was able to conduct a survey method to assess students' perception of e-learning. The respondents comprised grades 5 and 6 learners.

3. The research data remained confidential throughout the study.

Results and Discussion

This chapter presents analyses and interprets the data collected in the study. For clarity of presentation and consistency in the discussion, the data are presented following the order and sequence of the questions raised in Chapter 1, to wit: (1) learning objectives as determined by needs assessment to be included in the supplementary learning material (2) appropriate design methods to be used (3) validity of the supplementary learning material based on the content quality, instructional quality, technical quality, and other findings. (4) implications derived from the findings of the study. The first stage of the development of the interactive module is the analysis phase. This phase includes determining the students' preference for the use of e-learning using a validated questionnaire and competency analysis that outlines the contents to be included in the making of an interactive module based on the mean percentage score of the results of the Division Achievement Test in Science 6 last school year 2020-2021.

The study sought to determine the student's perception of e-learning. They were asked to answer the scale which measured their (1) Perceived Usefulness of E-learning, (2) Perceived Self-Efficacy of Using E-learning, (3) Perceived Ease of Use of E-learning, and (4) Behavioral Intention of Using E-learning. These variables were quantified using the following scale; Strongly Agree (5), Agree (4), Neutral (3), Disagree (2), and Strongly Disagree (1).

Research Question 1: What learning objectives, as determined by a needs analysis, could be included in the supplementary learning module?

Table 3: Mean Score, Weighted Mean, and Descriptive Interpretation on The Assessment of The Respondents Regarding Their Perceptions Towards The Use of E-Learning

INDICATORS	MEAN SCORE	DESCRIPTIVE INTERPRETATION
I. Perceived Usefulness of E-learning		
Studying through e-learning mode gives the flexibility to study at a time convenient to the learner	4.06	Agree

E-learning can enable people to study irrespective of where they are located in the world	4.37	Agree
There are technologies available to enable one to take tests and submit assignments electronically	4.54	Strongly Agree
There are electronic tools available to enable interactive communication between instructor and student without meeting face-to-face	4.46	Agree
Weighted mean	4.35	Agree
II. Perceived Self-Efficacy of Using E-learning		
I feel confident while using the e-learning system.	4.29	Agree
I feel confident while operating e-learning functions.	4.54	Strongly Agree
I feel confident while using online-learning content.	4.40	Agree
Weighted mean	4.41	Agree
III. Perceived Ease of Use of E-learning		
I believe e-learning platforms are user friendly	4.37	Agree
It would be easy for me to find necessary information when using an e-learning platform.	4.51	Strongly Agree
I believe that using e-learning services can simplify the the-learning process.	4.57	Strongly Agree
The set-up of the e-learning service is compatible with the way I learn.	4.80	Strongly Agree
Weighted mean	4.56	Strongly Agree
IV. Behavioural Intention of Using E-learning		
I intend to use e-learning to assist my learning.	4.17	Agree
I intend to use e-learning to get update my subject knowledge with the latest amendments.	4.66	Strongly Agree
I intend to use e-learning as an autonomous (free) learning tool.	4.29	Agree
Weighted mean	4.37	Agree

**Legend: Strongly Agree - 5.0 - 4.50, Agree- 4.49-3.50, Neutral- 3.49 - 2.50, Disagree 2.49 -1.5, Strongly Disagree 1.49 - 1.0*

The respondents have indicated their perceptions and their capability to make use of e-learning platforms. As presented in Table 3, the responses received show that respondents have a positive perception of e-learning. As indicated in the weighted mean score, each indicator received a favorable response from the learners. Their perception ranges from Strongly Agree to Agree, as revealed with a weighted mean of 4.35, 4.31, 4.56, and 4.37, respectively.

The researcher sought to determine the usefulness of the e-learning resources. It was found that respondents believed that studying through e-learning mode provides the flexibility to study at a time convenient to the learner. The respondents believed that e-learning enables students to pursue their studies irrespective of geographical disparities and facilitates exams and submission of assignments electronically. In the last variable, respondents agreed that the effectiveness of communication indeed is possible between instructor and learner

without face-to-face interaction. This indicator garnered a mean score of 4.06, 4.37, 4.54, and 4.46, respectively.

For "Perceived Self-Efficacy of Using E-learning," students are confident while using e-learning systems, operating e-learning functions, and using e-learning content. This indicator obtained a mean score of 4.29, 4.54, and 4.40, respectively.

In terms of "Perceived Ease of Use of E-learning," the students agreed that e-learning platforms are user-friendly. Overall, students have noticed that using an e-learning system allows them to quickly access the necessary information and that using a web-based learning system simplifies the learning process. In the last variable, the students strongly agreed that the e-learning service's setup is compatible with their learning style. This indicator garnered a mean score of 4.37, 4.51, 4.57, and 4.80, respectively.

The purpose of this study is to investigate learners' behavioral intentions when it comes to using e-learning tools. The findings in Table 3 show that students agreed that using e-learning is a learning aid; they strongly agreed that using e-learning is for updating their subject knowledge and keeping track of any amendments, and they strongly agreed that using e-learning is a free-learning tool. The study's main findings show that students' behavioral intentions toward e-learning are encouraging and positive. Students' perceptions of interactive e-learning are expected to have a positive impact on their satisfaction. This indicator garnered a mean score of 4.17, 4.66, and 4.29, respectively.

Based on the results of the survey, it was found that students preferred the use of interactive learning material during the modular distance learning setup. In the analysis phase, the instructional problem was clarified, the instructional objectives and goals were

established, and the students' environment, existing knowledge, and skills were discerned. In this phase, the researcher gathered information about the students' needs based on the results of their Division Achievement Test in Science during the school year 2020-2021.

Table 4 shows the results, which revealed that out of 6 competencies included in Most Essential Learning Competencies (MELCS) of Science 6-Quarter 4, only four topics have low performance with a score of 47 %, 48%, 46 %, and 49 %, respectively. This shows the lack of content mastery of the lessons and indicates academic underachievement. A needs assessment was conducted as the initial stage of the module design to determine the contents included in the interactive module. With this, the most difficult topics were revealed using the mean percentage score (MPS) of each competency.

Table 4: Learning Competencies of Science 6-Quarter 4 Based on MELCS, Which Got A Low Proficiency Level Based on The Division Achievement Test in Science Last SY: 2020-2021

COMPETENCIES	CODE	MEAN PERCENTAGE SCORE	MASTERY LEVEL
1. Describe the changes on the Earth's surface as a result of earthquakes and volcanic eruptions	S6ESIVa1	47 %	Low Proficient
2. Describe the different seasons in the Philippines	S6ESIVc-3	48 %	Low Proficient
3. Differentiate between rotation and revolution and describe the effects of the Earth's motions	S6ESIVe-f-5	46 %	Low Proficient
4. Compare the planets of the solar system	S6ESIVg-h-6	49 %	Low Proficient

**Legend: Highly Proficient- 90 %-100 %, Proficient- 75 %-89%, Nearly Proficient- 50%-74%, Low Proficient- 25%-49%, Not Proficient- 0%-24%*

Research Question 2: What appropriate methods of designing phase will be used to create the interactive module?

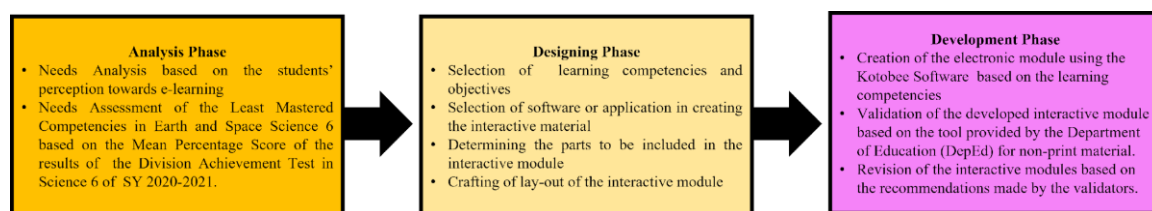


Figure 2: The Scheme of The ADDIE Model in the Development and Validation of the Interactive Learning Module

Following the analysis phase, the researcher created an overall outline for how the instruction will be communicated during the design phase. This includes deciding on the software to be used to

create the interactive module's prototype and developing practical intervention learning objectives to guide the learning process. Second, the learning materials were designed during this phase

using the data gathered during the need analysis. Based on the information gathered, the researcher developed the interactive module based on all of the data obtained regarding the students' learning needs and the difficulties they encountered while learning

the topics reflected in Table 2. As a result, the materials were developed in response to their perceptions of the use of e-learning, and the contents were solely based on competencies in which learners have a low mastery level.

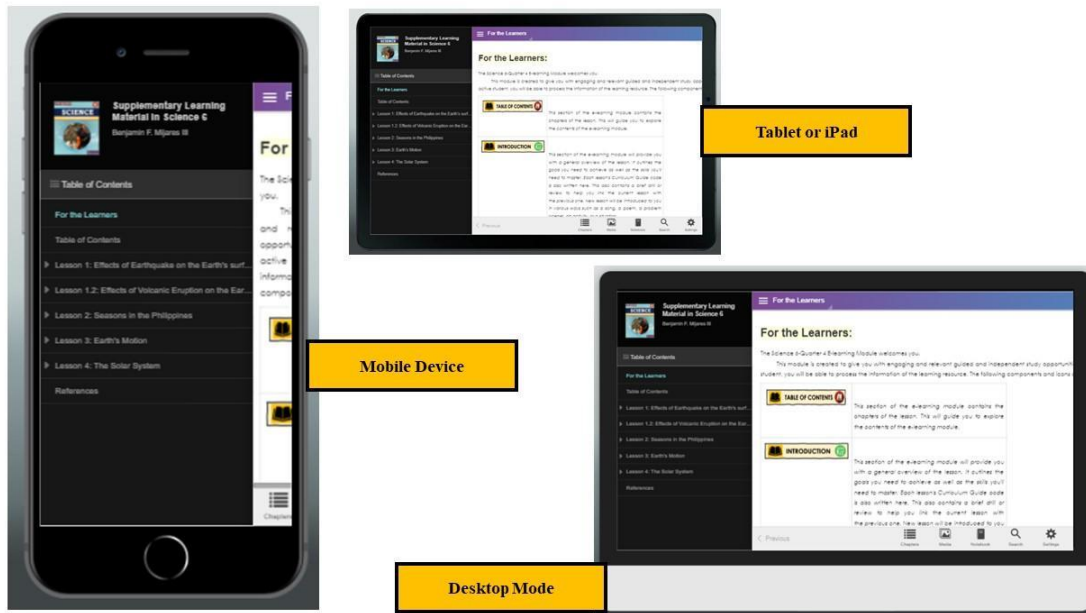


Figure 3: Overview of the Interactive Module Using Different Platforms

Kotobee Author is the main authoring tool used in the development of the lessons. The Kotobee Author is a comprehensive E-Book creator and EPUB editor suitable for education, training, and publishing. Vijua is Kotobee Author's publisher. Figure 4

depicts the various ways in which the user can manipulate the interactive module. It can be viewed on various platforms depending on the students' available devices. The contents can be viewed in either portrait or landscape mode.



Figure 4: Built-in Features of Interactive Module

Figure 4 highlights the technical elements integrated into the authoring tool, including audio-visual presentation, interactive quizzes, images and

graphics created with Adobe Photoshop and PowerPoint, Open Educational Resources (OER), and video lessons that are labeled as open-licensed

videos from YouTube, online animation and game-based application. The eBook reader (Kotobee Reader) itself has a built-in tool that will guide the learners to navigate the content of the interactive module.

The developed interactive module can be published on any student-enabled device, such as smartphones, tablets, laptops, and desktop computers, as long as Kotobee Reader is installed. After being downloaded by students, it can be used offline.

The eBook Cover is the part showing the name of the publisher, rights, and language. The Chapter

displays the table of contents of the e-module. The lesson order, solution key, and reference can be found here. The Media contains images, sounds, videos, and other animations. The Search tool allows students to search the entire module in a group of interactive modules. This will also allow students to use it when they are looking for a chapter in the module without opening the table of contents. Lastly, the setting which allows students to navigate through the current e-module if they want to change or edit it. Students can change the size, type, or color of the text, the color of the background, view, and animation of the interactive module.

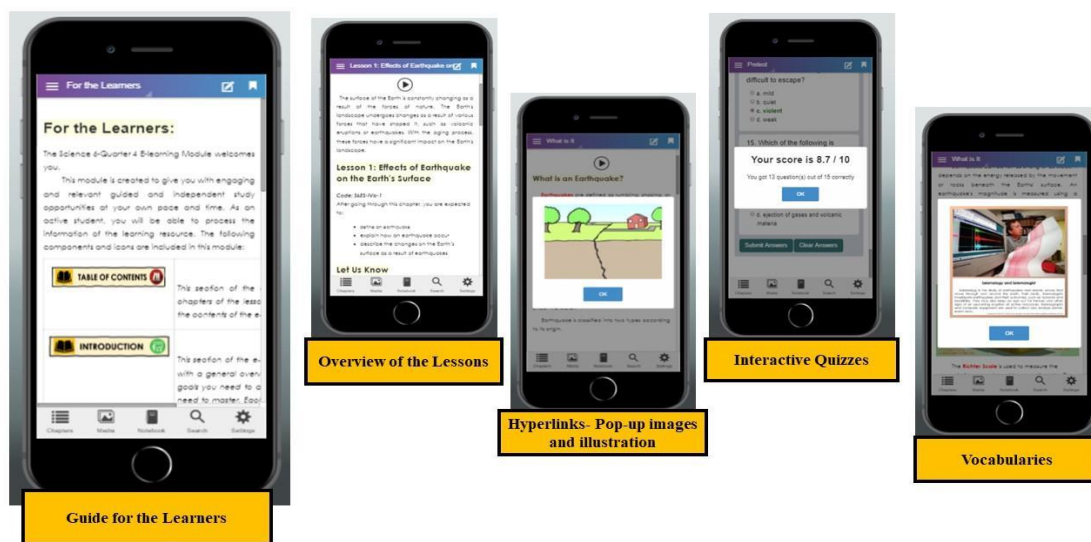


Figure 5: Interactive Parts of the Module

Figure 5 shows the interactive parts of the module, such as the use of hyperlinks, interactive quizzes, and vocabulary. It has a guide that helps the learners on how to use the module at the start and the end of the lesson. The template design of the E-Module is aligned with the Alternative Delivery Model (ADM) Module recommended by the Department of Education with the following parts:

- a. **Table of Contents:** This section of the e-learning module contains the chapters of the lesson. This will guide you to explore the contents of the e-learning module.
- b. **Introduction:** This section of the e-learning module will provide you with a general overview of the lesson. It outlines the goals you need to achieve as well as the skills you'll need to master. Each lesson's Curriculum Guide code is also written here. This also contains a brief drill or review to help you link the current lesson with the previous one. A new lesson will be introduced to you in various ways, such as a song, a poem, a problem opener, an activity, or a situation.

- c. **What Is It:** This section contains a summary of the lesson. This is intended to assist you in discovering and comprehending new concepts and skills. This also contains pop-up messages and images that will give you relevant information.
- d. **Let Us Practice:** This section contains tasks for individual practice to help you strengthen your knowledge and abilities on the topic.
- e. **Let Us Practice More:** This comprises activities for independent practice to check your understanding and skills of the topic.
- f. **What I Can Do:** This section has an activity that will assist you in applying your newly acquired knowledge or skill to real-life situations.
- g. **Let Us Remember:** This section contains the important part of the lesson that you need to remember. It highlights the necessary details that you have to master.
- h. **Assessment:** This is a test designed to assess your proficiency in attaining the learning competency. This part of the

assessment includes the pretest and posttest. A pretest is given to students at the beginning of a course to determine their initial understanding of the measures stated in the learning objectives, and a posttest is

conducted just after completion of the course to determine what the students have learned.

- i. **References:** This is a list of all sources used in developing this e-learning module

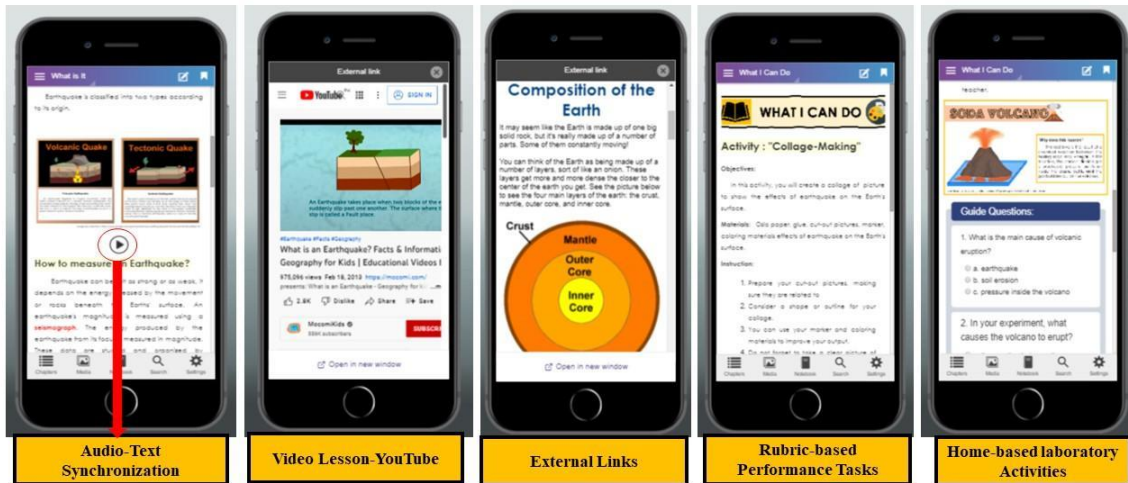


Figure 6: Audio-Visual and Performance-based Tasks

Figure 6 shows the other parts of the interactive module, such as the audio-text synchronization that will aid struggling readers. The module also contains video lessons from youtube that serves as an external source, as well as some reliable sites which like PHIVOLCS, PAG-ASA, DOST, and NASA. Learners can also apply the knowledge in real-life settings using the rubric-based tasks in which instructions are provided. The learning material also consists of an audio-visual presentation that will most likely encourage learners

to learn. Audiovisual materials are important in the education system. Audiovisual materials are devices used in the classroom that enhance the teaching and learning process and make it easier and more interesting. Audiovisual materials are the best tool to make your lessons effective and disseminate your knowledge in the best possible way. It helps to increase the retention of knowledge and skills of the students in Science (Lapada & Lapada 2017).



Figure 7: Online and Offline Resources Part of the Module

Figure 7 an interactive activity, simple game, and online 3D model used to introduce a concept or topic or as enrichment is also possible in Kotobee Author. Teachers can use Book Widgets or other tools to create a variety of interactive content. It can be accessed online, provided that learners have a stable internet connection. Infographics can be accessed offline, and it summarizes the topic so students can remember it. The interactive modules also have their reference page, which contains all the links and sources used.

Research Question 3: How valid is the created supplementary learning module in terms of the following categories;

In the validation stage, selected teachers were asked to evaluate the modules based on terms of their Content Quality, Instructional Quality, Technical Quality, and Other Findings. Suggestions were incorporated into the final output to improve the overall quality of the interactive module. Likewise, evaluators rated the material using the evaluation rating sheet in a word document format sent via Gmail. The validators' assessment results generally indicate that the interactive material obtained valid results in every aspect. This means that the validated interactive learning material will be worth testing for students.

Table 5: Profile of Validators

VALIDATORS	CRITERIA VALIDATED	DESIGNATION AND EXPERTISE
Teacher A	Factor A, B, and D	Master Teacher II/Module Writer and Content Evaluator
Teacher B	Factor A, B, C, and D	Master Teacher II/Module Writer, Content Evaluator, and ICT Expert
Teacher C	Factor A, B, and D	Master Teacher I/ Module Writer
Teacher D	Factor C	Teacher III/ ICT Coordinator, Content Evaluator, and Media Developer
Teacher E	Factor C	Teacher I/ LRMDS Coordinator, Book Author, and Module Writer

Table 5 shows the profile of the validators. These validators are responsible for checking if the developed interactive material is recommended for possible use in public schools. A total of five validators assessed the supplementary material, and each of them has the background and expertise in making and evaluating supplementary material.

Based on the table, Teachers A, B, and C evaluated Factor A: Content Quality, Factor B: Instructional Quality, and Factor D: Other Findings. On the other hand, Teachers B, D, and E assessed the supplementary learning material in terms of its Factor C: Technical Quality.

Table 6: Validation as to Content Quality- Factor A (Second Validation)

Factor A. Content Quality	Teacher A	Teacher B	Teacher C	Descriptive Interpretation	Mean Score
1. Content is consistent with topics/skills found in the DepEd Learning Competencies for the subject and grade/year level it was intended for.	4	4	4	Very Satisfactory	4
2. Concepts developed to contribute to enrichment, reinforcement, or mastery of the identified learning objectives.	4	4	4	Very Satisfactory	4
3. Content is accurate.	4	4	4	Very Satisfactory	4
4. Content is up to date.	4	4	4	Very Satisfactory	4
5. Content is logically developed and organized.	4	4	4	Very Satisfactory	4
6. Content is free from cultural, gender, racial, or ethnic bias.	4	4	4	Very Satisfactory	4

7. Content stimulates and promotes critical thinking.	4	4	4	Very Satisfactory	4
8. Content is relevant to real-life situations.	4	4	4	Very Satisfactory	4
9. Language (including vocabulary) is appropriate to the target user level.	4	4	4	Very Satisfactory	4
10. Content promotes positive values that support formative growth.	4	4	4	Very Satisfactory	4
Total Points	40 pts				

**Resource must score at least 30 points out of a maximum of 40 points to pass this criterion*

Table 6 presents the second validation results on each statement about the content quality of the supplementary learning material. It shows that each statement got a score of 4 which resulted in a total score of 40 points. It indicates that the supplementary learning materials passed the criterion. According to Memebre and Anadia (2015), it is suggested that the contents of supplementary learning materials must be carefully assessed following the content criterion provided by the DepEd so it can be used as instructional material to improve science teaching, facilitate the learning process, and, most importantly, to improve student achievement on least mastered competencies. This is also supported by Maliga (2018), who stated that the contents of learning materials must be valid and acceptable.

Table 7 presents the second validation results on each statement about the instructional quality of the supplementary learning material. It shows that each statement got a score of 4 except for criterion number 4. "Level of difficulty is appropriate for the intended target use," which garnered a mean score of 3.66. The validators rated the supplementary learning material a total score of 39.66 points.

This means that it passed the instructional quality. According to Estacio (2016), instructional materials should emphasize embedding skills and knowledge in holistic and realistic contexts. Anchored contexts support complex and ill-structured problems in which learners generate new knowledge and sub-problems while determining how and when knowledge is used.

Table 7: Validation as to Instructional Quality- Factor B (Second Validation)

Factor B. Instructional Quality	Teacher A	Teacher B	Teacher C	Descriptive Interpretation	Mean Score
1. Purpose of the material is well defined.	4	4	4	Very Satisfactory	4
2. Material achieves its defined purpose.	4	4	4	Very Satisfactory	4
3. Learning objectives are clearly stated and measurable.	4	4	4	Very Satisfactory	4
4. Level of difficulty is appropriate for the intended target user.	4	3	4	Very Satisfactory	3.66
5. Graphics / colours / sounds are used for appropriate instructional reasons.	4	4	4	Very Satisfactory	4
6. Material is enjoyable, stimulating, challenging, and engaging.	4	4	4	Very Satisfactory	4
7. Material effectively stimulates the creativity of the target user.	4	4	4	Very Satisfactory	4
8. Feedback on target users' responses is effectively employed.	4	4	4	Very Satisfactory	4
9. Target users can control the rate and sequence of	4	4	4	Very Satisfactory	4

presentation and review.

10. Instruction is integrated with the target user's previous experience. 4 4 4 Very Satisfactory 4

Total Points 39.66 pts

**Resource must score at least 30 points out of a maximum of 40 points to pass this criterion.*

Table 8 highlights the second validation result as of technical quality. The validators agreed that the supplementary learning material met the criteria. The material is easy to use, and it can be used in distance learning, provided that learners have the device used to operate the learning material. However, in statement 12, which indicates that the material will run using minimum system requirements, the only concern of validators was some parts of the supplementary learning material can only be accessed using an internet connection which they thought was a problem if students do not have the means of good internet connection. The learning material obtained a total score of 53 points, and it passed the technical quality. This is parallel to the study of Aquino (2018) which he stated that the illustrations could attract attention, aid retention, enhance understanding, or create context.

As technology evolves, the importance of technology in education will grow too. Teachers not only need training on how to take their students into

the future with the next technological invention but also need to stay abreast and use this technology in their own lives to effectively use it in the classroom at different learning modalities. The validators emphasized that the supplementary learning material is appropriate for learners as it provides comprehensive information with the use of illustrations, audio-visual, and digital resources.

It can stimulate learners' hearing and visual skills. Basilan (2018) said that electronic devices could perform many of the functions of a personal computer while taking up less space and cost. Students can interact with the subjects by using a computer or mobile-based applications. Furthermore, each student can work at his or her own pace. It focused on how educators can use new technology and the internet to improve teaching. It is predicted that internet-connected devices will assist teachers in the assessment, collaboration, data collection, and analysis needed to support student learning.

Table 8: Validation as to Other Findings - Factor D (Second Validation)

Factor D. Other Findings	Teacher A	Teacher B	Teacher C	Descriptive Interpretation	Mean Score
1. Conceptual errors	4	4	4	Present	4
2. Factual Errors	4	4	4	Present	4
3. Grammatical and / or typographical errors.	4	4	4	Present	4
4. Other errors (i.e., computational errors, obsolete information, errors in the visuals, etc.).	4	4	4	Present	4
Total Points	16 pts				

**Resource must score at least 16 points out of a maximum of 16 points to pass this criterion*

Table 8 highlights the second validation results as to Other Findings, which include conceptual errors, factual errors, grammatical and typographical errors, computational errors, obsolete information, and errors in visuals. The validators agreed that the

supplementary learning material met the criteria. Based on the validators' responses, it was evident that the supplementary learning material was adequate and accurate in information. The content is updated and informative. However, the validators

noticed that there were some typographical errors, but it was already modified as recommended.

Table 9: Results of Second Validation based on the criteria for Non-print materials provided by the Department of Education-DepEd

Criteria	Scores Obtained	Required Points	Remarks
Factor A: Content Quality	40	40	Passed
Factor B. Instructional Quality	39.66	40	Passed
Factor C. Technical Quality	51	52	Passed
Factor D. Other errors (i.e., computational errors, obsolete information, errors in the visuals, etc.).	16	16	Passed

Based on the table above shows that the interactive module is approved based on the criteria for non-print materials provided by the Department of Education (DepEd). The supplementary learning material passed the four factors, and it obtained valid results for every aspect during its second evaluation. It is recommended for possible use in public schools provided that the corrections and revisions included in the other comments provided by the validators are made. The results of the second validation are congruent with the study conducted by Manalastas and De Leon (2021), where the same software was used to develop an interactive module in Science. The E-Module used content in authentic ways for students. The examples were relevant and realistic that learners could understand. It is also supported by Mayen (2017), where instructional modules provide learner competencies and opportunities to master the material when used. Because a well-planned module teaches concepts in a logical order. Similar to the current study, the "Development and

Evaluation of Localized Digital Learning Modules for Indigenous Peoples' Health Education in the Philippines," authored by Tolentino et al. (2020), was accepted as action research by the evaluators with a "Very Satisfactory" rating using a similar instrument (Evaluation Rating Sheet for Non-Print Materials). The personal health and hygiene lessons taught to Aetas in Pampanga were also structured in a digital learning module. Instead of Kotobee Author, Adobe Animate (formerly known as Adobe Flash) was used as the authoring tool. Each element's colors and depths were also enhanced using Adobe Photoshop. The background scene, images, characters, and videos were all created with the indigenous people in mind. More appealing, memorable, and reflective. Also, Li et al. (2018) emphasized that the relationship between motivation for better assessment and learning satisfaction, as well as the relationship between internal motivation and learning satisfaction, is significantly influenced by the use of interactive materials.

Table 10: Inter-Rater Reliability: Test of Internal Consistency and Absolute Agreement Among Validators on the Quality of Developed Supplementary Learning Material during the First Evaluation

Validator	Mean	Cronbach Alpha	Intraclass Correlation Coefficient	p-value	Interpretation
Teachers A and B	3.22	0.958 (Excellent)	0.958 (Excellent)	p<0.001	Significant
Teachers B and D	3.24				
Teachers C and E	3.30				

Table 10 shows the results of the inter-rater reliability content, instructional and technical quality, and other findings of the developed supplementary learning material during the first evaluation analyzed using the Cronbach Alpha Test of Internal Consistency and Intraclass Correlation Coefficient in Absolute Agreement definition. The results show that there was an excellent internal

consistency and absolute agreement among the validators on the quality of supplementary learning material during the first evaluation (Cronbach Alpha=0.958, ICC=0.958, p<0.001). This indicates that not only that the ratings were internally consistent across validators, but an absolute agreement among them was also established.

Table 11: Inter-Rater Reliability: Test of Internal Consistency and Absolute Agreement Among Validators on the Quality of Developed Supplementary Learning Material During the Second Evaluation

Validators	Mean	Cronbach Alpha	Intraclass Correlation Coefficient	p-value	Interpretation
Teachers A and B	3.97	0.898	0.898	p<0.001	

Teachers B and D	3.95	(Good)	(Good)	Significant
Teachers C and E	3.97			

Table 11 presents the results of the inter-rater reliability content, instructional and technical quality, and other findings of the developed supplementary learning material during the second evaluation analyzed using the Cronbach Alpha Test of Internal Consistency and Intraclass Correlation Coefficient in Absolute Agreement definition. The results show that there was a good internal consistency and absolute agreement among the

validators on the quality of supplementary learning material during the second evaluation (Cronbach Alpha=0.898, ICC=0.898, $p < 0.001$). Although the degree of internal consistency and absolute agreement among the validators slightly declined from the first evaluation, there was still a significance, as evidenced by the p-value of less than 0.05.

Table 12: Paired Correlation and T-Test. Significant Correlation and Difference in the Ratings of the Validators on the Quality of Developed Supplementary Learning Material of the Two Evaluations Rendered Using the Test-Retest Method

Evaluation	Mean	Mean Difference	Paired Correlation		Paired T-test	
			R	p	t	p
First Evaluation	3.25	-0.71	0.035	0.858	-7.859	0.001
Second Evaluation	3.96		(Not significant)		(significant)	

Table 12 summarizes the significant correlation and difference between the two evaluations rendered on the developed learning material using paired correlation and paired t-test. Based on the results, there was no statistical evidence to support that the first evaluation is significantly correlated or associated with the second evaluation ($r=0.035$, $p=0.858$). Although not correlated, there was a significant difference between the first and second evaluations ($t=-7.859$, $p < 0.001$). This indicates that there must be a significant improvement in the quality of the proposed learning material from the first to the final evaluation.

Research Question 4: Based on the findings of the study, what implications may be drawn?

Based on the results, it revealed that the developed supplementary learning material is valid and has met all the specific standards for DepEd’s non-print learning material. It is recommended as learning material for Science at Elementary Level.

Implications Drawn from the Findings of the Study

Based on the findings of the study, the research paper made the following implications:

1. The study reveals the perception of students towards the use of E-learning. It was emphasized in the data that learners have developed a positive perception of the use of E-learning incorporated in their learning modality. E-learning offers an encouraging and engaging learning environment among learners. They were satisfied with the benefits they got from the use of e-learning in their class. Their perception of the use of e-learning may reveal the need to maximize the use of technology in the classroom and its

incorporation into different learning modalities. Depending on many factors related to instruction and students' interest in learning, students' learning motivations can change positively or negatively. The current findings of this study regarding the positive impact of E-learning on students' learning reflect their belief that using technology to enhance learning interest will motivate them to learn.

2. Technology is always changing. Therefore, there is a need for ongoing retooling of best practices in online education. Teachers can effectively design and use interactive online learning resources for students if they are trained, supported, and motivated. ICT proficiency boosts self-assurance, drive, and enthusiasm for creating and utilizing online learning resources successfully. The development of supplementary learning material is vital in helping the learners achieve the desired learning outcome. To ensure that efficient interactive online resources are created and routinely assessed for relevance, this knowledge can be cascaded to others. The study reveals that it is necessary to continuously produce quality learning materials in different formats, such as printed or non-print, that will help struggling learners.
3. It takes time, effort, and commitment to developing effective supplementary learning material. This would be better accomplished during limited busy times at the school in terms of teaching and other duties so that they are not overburdened by activities or outside the school environment to allow for maximum concentration. They

encourage teachers to have a work plan to finish the learning material on time. Institutional support is highly encouraged to boost teachers' motivation.

4. Validation is highly advisable to improve the overall characteristics of any supplementary learning material made. This will allow teachers to change certain parts that need revision. Validating instructional materials is critical before they are widely used to ensure quality. The study reveals that teachers should look for a standardized tool that focuses on accuracy and visual appeal, alignment to standards and depth of knowledge, ease of use and support, engagement, and ability to meet student needs.

Conclusion

In light of the findings of the study, the following conclusions were drawn:

The students developed a positive perception of the use of E-learning.

The contents of the supplementary learning material include competencies with low proficiency levels. The content quality, instructional quality, technical quality, and other findings of the supplementary learning material passed the qualification standards for DepEd-LRMDS non-print material. This indicates that all descriptors under each factor in the evaluation of the supplementary learning material in the form of an interactive module were successfully passed.

The Cognitive Theory of Multimedia Learning supported the study's findings that students learn better from images and words than just words alone about their perception of the use of E-learning. Students have a more positive learning experience when they use multimedia learning materials. The study made use of audio-visual information and interactive elements as part of the ADDIE framework and was successful as it integrated with existing knowledge.

The study includes only used the first three stages of the ADDIE Model, which are the analysis, designing, and development phases. The remaining two stages, the implementation phase and the evaluation phase, were recommended for further research.

Recommendations

The development of supplementary learning material is systematic and ensures the development of students' higher-order thinking skills.

1. Conduct a different study on the implementation of the validated

supplementary material to test its effectiveness and complete the stage in the ADDIE Model. Furthermore, it is subjected to pilot testing and can be done on either small or large groups of students to further assess its quality and effectiveness.

2. Make the best use of e-learning in the blended learning modality. It can be used as an alternative method of communicating with students in face-to-face classes are not possible as long as a good internet connection is available. Teachers can incorporate it into online learning platforms such as the Learning Management System, Edmodo, or Google Classroom, which are frequently used in the Blended Learning Modality, or when the E-Module is exported as a web, mobile, or desktop app.
3. The study utilized the standard evaluation tool for a non-print learning material produced by the Department of Education (DepEd); however, it is recommended to use the International Organization for Standardization ISO-25010. It is a software quality evaluation tool. It describes the models, which are made up of characteristics and sub-characteristics, for both software product quality and software quality in use, as well as practical advice on how to use the quality models. It provides consistent terminology for specifying, measuring, and evaluating the quality of system and software products. They also provide a set of quality characteristics that can be compared for completeness to stated quality requirements. This is an international standard evaluation tool that is widely used in assessing the quality of software products like computer-based learning material such as eBooks and E-learning modules.

Conflict of Interest

There is no conflict of interest by the author in this manuscript.

References

1. Abdu-Raheem, B. (2016). Effects of Instructional Materials on Secondary Schools Students' Academic Achievement in Social Studies in Ekiti State, Nigeria. *World Journal of Education*, DOI: 10.5430/wje.v6n1p32.
2. Abouhashem, A., Abdou, R. M., Bhadra, J., Santhosh, M., Ahmad, Z. & Al-Thani, N. J. (2021). A Distinctive Method of Online Interactive Learning in STEM Education. *Multidisciplinary Digital Publishing Institute (MDPI)*, 13(24), 13909 <https://doi.org/10.3390/su132413909>.
3. Antigua, R. A. (2017). Development And Evaluation of An Interactive Learning.

- Mathematics Division Institute of Mathematical Sciences and Physics College of Arts and Sciences University of the Philippines Los Baños.
4. Anzaldo, Geraldine (2021). Modular Distance Learning in the New Normal Education Amidst Covid-19. *International Journal of Scientific Advances*, 2, 263-266. [10.51542/ijscia.v2i3.6](https://doi.org/10.51542/ijscia.v2i3.6).
 5. Aquino, J. (2018). Improving The Performance of Intermediate Pupils in Science Using Interactive Multimedia Presentations.
 6. Aquino, P. M. (2018). Development, Validation and Effectiveness of Enhancement. *Asian Journal of Multidisciplinary Studies*, ISSN 2651-6691 (Print).
 7. Arrieta, G. S., Dancel, J. C. & Agbisit, M. P. (2020). Teaching Science in The New Normal: Understanding The Experiences of Junior High School Science Teachers. *Jurnal Pendidikan MIPA*, 21(2) DOI: <http://dx.doi.org/10.23960/jpmipa/v21i2.pp146-162>.
 8. Asio, J. M. R. & Jimenez, E. C. (2020). Effect of Remediation Activities on Grade 5 Pupils' Academic Performance in Technology and Livelihood Education (TLE). *Pedagogical Research*, 5(4), em0075. <https://doi.org/10.29333/pr/8464>
 9. Auditor, E. and Naval, D. J. (2014). Development and Validation of Tenth Grade Physics Modules Based on Selected Least Mastered Competencies. *International Journal of Education and Research*, 2(12).
 10. Barrot, J. S. (2021). Social media as a language learning environment: A systematic review of the literature (2008-2019). *Computer Assisted Language Learning*. <https://doi.org/10.1080/09588221.2021.1883673>.
 11. Barrot, J. S., Llenares, I. I. & del Rosario, L. S. (2021). Students' online learning challenges during the pandemic and how they cope with them: The case of the Philippines. Springer Science, <https://doi.org/10.1007/s10639-021-10589-x>.
 12. Barantes, A.K.A. & Tamoria, J.R. (2021). LARO (Learners Active Response to Operant) lessons in improving the basic science process skills of elementary pupils. *JPBI (Jurnal Pendidikan Biologi Indonesia)*, 7(1), 11-24. doi: <https://doi.org/10.22219/jpbi.v7i1.15510>
 13. Baterna, H. B., Mina, T. D. G. & Rogayan, D. V. Jr. (2020). Digital literacy of STEM senior high school students: Basis for enhancement program. *International Journal of Technology in Education*, 3(2), 105-117. <https://www.ijte.net/index.php/ijte/article/view/28>
 14. Bernardo, J. (2020). Modular Learning most preferred parents: DepEd. ABS-CB News. <https://news.abs-cbn.com/news/07/30/20/modular-learning-most-preferred-by-parentsdep>
 15. Bungahan Elementary School (2021). Results of Division Achievement Test in Science 6.
 16. Cahapay, M. B., & Labrador, M. P. (2021). Experiments Gone Wrong? Lived Experience of Filipino Teachers in Remote Science Education amid COVID-19 Crisis. *Asian Journal of Science Education*, 3(2), e-ISSN 2715-5641.
 17. Chávez, J., Montaña, R., Barrera, R., Sánchez, J. & Faure, S. (2021). Quality of Online Learning Participation in a Context of Crisis. *Higher Learning Research Communications*, 11, 72-87. DOI: 10.18870/hlrc.v11i0.1203.
 18. CHILDHOPE (2021). The Importance of Technology in Philippine Education. 1210 Peñafrancia Street, Paco, Manila, Philippines 1807: <https://childhope.org.ph/importance-of-technology-in-philippine-education/#>.
 19. Co, A. E., Magno, K. C. & De Jesus, F. S. (2021). Barriers to Effective Integration of Interactive Technology Learning Tools in Science Instruction. *Open Access Library Journal*, 8, e7724 .
 20. Corpuz, B. B. & Salandanan, G. G. (2015). Principles of teaching 2. Lorimar Publishing, Inc. https://books.google.co.id/books/about/Principles_of_Teaching_2_with_TLE.html?id=UPkKugEACAAJ&redir_esc=y
 21. Dangle, P. and Sumaoang, D. (2020). The Implementation of Modular Distance Learning in the Philippine Secondary Public Schools.
 22. Dayagbil, F. T., Garcia, L. L. & Olvido, M. J. (2021). Teaching and Learning Continuity Amid and Beyond the Pandemic. *Front. Educ.*, 6:678692. doi: 10.3389/educ.2021.678692.
 23. Day, T., Chang, I. C. C., Chung, C. K. L., Doolittle, W. E., Housel, J. & McDaniel, P. N. (2021). The immediate impact of COVID-19 on postsecondary teaching and learning. *The Professional Geographer*, 73(1), 1-13.
 24. De Guzman, C. (2021). The Philippines Still Hasn't Fully Reopened Its Schools Because of COVID-19. What Is This Doing to Children? TIME Philippines.
 25. DepEd. (2020). OUA MEMO 00-0420-0041 Memorandum, Webinar Training About The Use & Curation Of Open Educational Resources And E-Book Development And Design Authoring Tools Using Kotobee Author
 26. DOST (2018). DOST Courseware.
 27. Espina, K. E. (2021). Lessons-On-The-Go Instruction (Log In): A Melc-Based Electronic Supplementary Learning Material in Earth and Life Science for Senior High School Students in The New Normal Binan City Senior High School- Sto. Tomas Campus

28. Espinosa, A. A. (2018). Strategic intervention material-based instruction, learning approach and students' performance in chemistry. *International Journal of Learning, Teaching and Educational Research*, 2(1).
29. Estrellan, A., Ferrariz, K., Lazona, P., Madres, V. & Estrellan, J. C. (2021). E-Learning Amidst the Pandemic: Teachers' Perspective in the Philippines. *ASEAN Journal of Science and Engineering Education*, 93-96.
30. Fajardo, M. M., Bacarrissas, P. G., & Castro, H. G. (2019). The Effects of Interactive Science Notebook on Student Teachers' Achievement, Study Habits, Test Anxiety, and Attitudes towards Physics. *Journal of Turkish Science Education*, 16(1).
31. FT, D., Dr, P., LL, G. & MMJ, O. (2021). Teaching and Learning Continuity Amid and Beyond the Pandemic. *Front. Educ*, 6:678692. doi: 10.3389/educ.2021.678692.
32. Galvez, R. (2018). Effectiveness of Animated Visuals for The Teaching of Chemical Bonding in Junior High School Chemistry. *International Journal of Education and Research*, 6(1).
33. Garbe, U. Ogurlu, N. Logan and P. Cook, (2020). Parents' Experiences with Remote Education during COVID-19 School Closures. *American Journal of Qualitative Research*, 4(3), 45-65, doi: 10.29333/ajqr/8471.
34. Gillaco, M. (2014). Level of Word Recognition and Reading Comprehension: A Basis for a Reading Program. *Asia Pacific Journal of Education, Arts, and Sciences*, 1(5). Retrieved September 20, 2018, from www.academia.edu/download/51551597/APJEAS-2014-1-088.pdf
35. Goned, Mamerto & Rein, Jerry (2021). An Interactive E-Learning Design for the grade 12 Tvl-Ict Programming Using Kotobee of Lagro Senior High School.
36. Harsasi, M. (2015). The Use of Open Educational Resources in Online Learning: A Study of Students' Perception. *Turkish Online Journal of Distance Education-TOJDE*, ISSN 1302-6488, 16(3).
37. Kapasia, N., Paul, P., Roy, A., Saha, J., Zaveri, A., Mallick, R. & Chouhan, P. (2020). Impact of lockdown on learning status of undergraduate and postgraduate students during COVID-19 pandemic in West Bengal. *India. Children and Youth Services Review*, 116, 105194.
38. Kapri, D. (2017). Impact of Multimedia in Teaching of Science. *International Journal of Advance Research and Innovative Ideas in Education (IJARIIE)*, 3(4).
39. Karlin, M. (2017). *Kotobee Author: Creates Ebook for your Classroom*. The EdTech Round Up.
40. Khan, M.A., Vivek, Nabi, M.K., Khojah, M. & Tahir, M. (2021). Students' Perception towards E-Learning during COVID-19 Pandemic in India: An Empirical Study. *Sustainability* 13, 57. <https://dx.doi.org/10.3390/su13010057>
41. Kurnia, A., Sukarmin, S. & Sunarno, W. (2021). Development of Scientific-Based Electronic Science Modules to Improve Student Learning Outcomes in Knowledge Aspects During the Covid-19 Pandemic. *Advances in Social Science, Education and Humanities Research*, 630.
42. Lansangan, R. V. & Gonzales, K. J. (2020). Science Teachers' Voices in the New Normal Teaching: A Phenomenological Study. *IOER International Multidisciplinary Research Journal*, 2(3), 124 - 132.
43. Lapada, A. & Lapada, A. (2017). Audio-visual Aided Instruction in Science Among High School Students in the Philippines.
44. Li, et al., (2018). The influence of interactive learning materials on self-regulated learning and learning satisfaction of primary school teachers in Mongolia. *Tokyo Institute of Technology, Tokyo, Japan*
45. Lebeničnik, M., Pitt, I. & Istenič, A. (2015). Use of Online Learning Resources in the Development of Learning Environments at the Intersection of Formal and Informal Learning: The Student as Autonomous Designer. *Center for Educational Policy Studies Journal*, 5(2).
46. Lubiano, M D. (2018). Interactive E-Learning Portal for Enrichment of Conceptual Understanding of Grade 8 Learners in Physics. *Tilamsik: The Southern Luzon Journal of Arts and Sciences*, 10, 37-50.
47. Lynch, M. (2020). 5 Advantages and 5 Disadvantages of E-Learning. *The Tech Advocate*.
48. Maliga, G. M. (2018). Content validity and effectiveness of supplemental learning materials in mathematics. A research funded by Basic Education Research Fund (BERF), DepEd-Regional Office, Carpenter Hill, Koronadal City, South Cotabato, Region XII, Philippines
49. Manalastas R. S. & De Leon S. P. (2021). Development and Evaluation of Electronic Instructional Module in Matter. *European Journal of Humanities and Educational Advancements*, 2(8), 107-127. Retrieved from <https://scholarzest.com/index.php/ejhea/article/view/1175>
50. MaričićA, O., Džigurski, A. I., Stojšić, I., Cvjetičanin, S. & Bibić, L. I. (2019). Multimedia Teaching Effectiveness in Natural Science Teaching. *Geographica Pannonica*, doi: 10.5937/gp24-23357.
51. Memebrebe. Nino Q. & Anadia Aiselle (2015). *Improving Student Achievement for Science in*

- Grade 7 using Strategic Intervention Material. Retrieved from [www.iamse.org/wp-content/uploads/2015/06/Science Education and Teaching](http://www.iamse.org/wp-content/uploads/2015/06/Science_Education_and_Teaching)
52. Moradi, M., Liu, L., Luchies, C., Patterson, M. M. & Darban, B. (2018). Enhancing Teaching-Learning Effectiveness by Creating Online Interactive Instructional Modules for Fundamental Concepts of Physics and Mathematics. *MDPI Education Sciences*.
 53. Mwaniki, E. W., Njihia, M. S., Chege, F. N., & Ileri, A. M. (2016). Development of Interactive Online Learning Modules: Lessons from Kenyatta University, Kenya. *RP-Department of Educational Communication and Technology*.
 54. Nardo, M. T. B. (2017). Modular instruction enhances learner autonomy. *American Journal of Educational Research*, 5(10), 1024-1034.
 55. Oribel, V. R., Tan, J. B. & Untalan, L. A. (2015). An Interactive Module for Pre-Service Teachers Teaching Grade 7 Science. *MSEUF Research Studies*, 17(1).
 56. Oronce, J. P. & Manalo, D. O. (2021). Development and Validation of Flipbook in Earth and Life. *IOER International Multidisciplinary Research Journal*, 3(1).
 57. Padua, S. S. & Cascolan, H. (2020). Development and Validation of a Multimedia Based-Module in Science for TVL Track. *ASEAN Journal of Basic and Higher Education*.
 58. Potane, Joel & Siano, Lordson. (2022). Using Interactive E-books to Improve Students' Academic Achievement in Mathematics. *United International Journal for Research & Technology*, ISSN: 2582-6832, 3, 30-36.
 59. Rafanan, R. J. & De Guzman, C. Y. & Rogayan, D.V. Jr. (2020). Pursuing STEM careers: Perspectives of senior high school students. *Participatory Educational Research*, 7(3), 38-58. <https://doi.org/10.17275/per.20.34.7.3>
 60. Rasheed, R. A., Kamsin, A. & Abdullah, N. A. (2020). Challenges in the online component of blended learning: A systematic review. *Computers & Education*, 144, 103701.
 61. Robarge, K. M. (2016). Using Interactive Lessons through Technology to Improve Students' Academic Performance. *Capstone Projects and Master's Theses*, 566.
 62. Rogayan, D. V. Jr. (2019). Retrospective evaluation of the science education program in a Philippine state university. *International Journal of Innovation, Creativity and Change*, 8(7), 352-369. <https://eric.ed.gov/?id=ED603046>
 63. Roblek, V., Mesko, M., Dimovski, V. & Peterlin, J. (2019). Smart technologies as social innovation and complex social issues of the Z generation. *Kybernetes*, 48(1), 91-107.
 64. Rogayan Jr, Danilo & Dollete, Lea (2019). Development and Validation of Physical Science Workbook for Senior High School. 30. 284-290. 10.33828/sei.v30.i4.5.
 65. Rogers, E. M. (2010). *Diffusion of Innovations*. New York: Simon and Schuster.
 66. Rotas, E. E. & Cahapay, M. B. (2020). Difficulties in Remote Learning: Voices of Philippine University Students in the Wake of COVID-19 Crisis. *Asian Journal of Distance Education*, 15(2).
 67. Schindler, L. A., Burkholder, G. J., Morad, O. A. & Marsh, C. (2017). Computer-based technology and student engagement: a critical review of the literature. *International Journal of Educational Technology in Higher Education*, <https://doi.org/10.1186/s41239-017-0063-0>.
 68. Talimodao, A. J. S. & Madrigal, D. V. (2021). Printed Modular Distance Learning in Philippine Public Elementary Schools in Time of COVID-19 Pandemic: Quality, Implementation, and Challenges. *Philippine Social Science Journal*, 4(3), 19-29. <https://doi.org/10.52006/main.v4i3.391>
 69. Taja-on, E., Miras, R. & Jurlan, C. (2021). E-Learning: Teaching Effectiveness to Conventional Teaching in Undergraduates amid COVID-19 Pandemic. *Open Access Library Journal*, doi: 10.4236/oalib.1108124.
 70. Torrefranca, E. C. (2017). Development and Validation of Instructional Modules on Rational Expressions and Variations. *The Normal Lights Journal on Teacher Education*, 11(1).
 71. Ullah, A. & Anwar, S. (2020). The Effective Use of Information Technology and Interactive Activities to Improve Learner Engagement. *Multidisciplinary Digital Publishing Institute, Education Sciences*.
 72. UNESCO (2021). *Annotating the UNESCO Recommendation on OER by UNESCO is licensed under a Creative Commons*, <https://oer.pressbooks.pub/oeg2021/>
 73. Valencia, M. R. (2020). Modular approach in teaching science 10. *International Journal of Trend in Scientific Research & Development*.
 74. Widyarningsih, S., Yusuf, I., Prasetyo, Z. K. & Istiyono, E. (2020). Online Interactive Multimedia Oriented to HOTS through E-Learning on Physics Material about Electrical Circuit. *Journal Pendidikan Indonesia JDP*, DOI: 10.23887/jpi-undiksha.v9i1.17667.