Supporting Conceptual Comprehension of Newton's Laws of Motion of Grade 8 Students through Kotobee Interactive E-Module

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Abstract

This study aimed to develop an interactive electronic module to support students' conceptual comprehension in Science 8 and find out if there would be a significant difference in the performance of students after using the electronic module. The e-module was composed of three topics with three sub-lessons in Newton's Laws of Motion. The participants were Grade 8 students and enrolled in the school year 2020-2021. Students from four different sections were divided into two groups: the controlled group (printed module) and the experimental group (e-module). The e-module was validated by nine experts for its content validation. Results showed that the pretest scores of the students in both the controlled and experimental groups had a remark of average mastery. The post-test mean scores showed a large difference between the two groups as the students using printed modules remained at average mastery level while students taking the e-module were moving toward mastery. T-test results also found that the pretest scores of the students using both methods of instruction were statistically significantly different from their post-test scores. The e-modules group had improved and increased gain scores in their posttest compared to the printed modules group. Still, both modules, whether printed or e-modules, contribute to the increased performance of the students. Moreover, the developed interactive e-module using Kotobee Author software met the criteria set for evaluating its validity in terms of material worthiness, media feasibility, and language eligibility in supporting students' conceptual comprehension of Newton's Laws of Motion. Overall, the value of the study was to search for the most effective ways of applying e-learning module in the learning process. Also, the study employed the effectiveness of using the e-module in the development of science teaching and by providing alternative ways to properly utilize the use of e-module in addressing and solving issues and problems in the teaching and learning process. The study would help improve the science curriculum with technology integration to be employed by teachers in the school environment.

Keywords: academic performance, educational leaders, e-module, interactive, learning module, newton's laws of motion, printed module, teaching innovation

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1. Introduction

The coronavirus disease (CoViD-19) pandemic had caused an unprecedented crisis in all areas. In the field of education, this emergency led to the massive closure of face-to-face activities of educational institutions in more than 190 countries to prevent the spread of the virus and mitigate its impact (CEPAL, 2020).

In the Philippines, around 27 million learners, 1 million teachers, and staff, and even the families of learners, were affected by the Covid-19 crisis (Obana, 2020). This great number of enrollees possessed a higher risk of transmission especially when social distancing and other precautionary measures were not fully enforced. Due to COVID-19's encompassing threat, educational leaders had

forced to shift to different modalities of teaching that do not require face-to-face interaction. The DepEd Order No. 12, s.2020 Re: Adoption of the Basic Education Learning Continuity Plan (LCP) for School Year 2020-2021 in Light of the COVID-19 Public Health Emergency released on June 19, 2020, to better address the current educational dilemma. The goal of this was to find ways for learning to continue amidst the threat and uncertainties brought about by COVID-19 while ensuring the health, safety, and well-being of all learners and teachers. The learning delivery that schools adopted varies depending on the COVID-19 restrictions and the particular context of the learners in the school or locality. In the case of the Agusan del Norte division, the distance learning modality took place between the teacher and the learners who were geographically remote from each other during instruction. Distance Learning as Alternative Delivery Modality has three types: Modular Distance Learning (MDL), Online Distance Learning (ODL), and TV/Radio-Based Instruction (DepEd Order No. 12, s. 2020).

In October 2020, the Department of Education (DepEd) reopened classes amid the rampant coronavirus outbreak; and one method of teaching the department appraised to be effective in this situation was modular learning. Modular Distance Learning was opted for by most of the schools in the said division. This modality involved individualized instruction that allowed learners to use self-learning modules (SLMs) in print or digital format/electronic copy. Malipot (2020) stressed that modular learning, based on the survey conducted by DepEd through the Learner Enrollment and Survey Form on the opening of classes in the School Year 2020-2021, was the most preferred learning of parents for their children this school year. Under modular learning, materials could be printed or in digitized form. This type of modality

was convenient, especially for students who cannot readily access an internet connection and does not involve sophisticated programming and instructional design (Luz, 2020). A survey by DepEd nationwide in the opening of classes this School Year 2020-2021 on how best to deliver educational content revealed that more learners (74%) expect to understand lessons using modules versus 58% for topics done online. Luz (2020) also added that there were supply chain concerns that will need constant fine-tuning: module development, quality assurance, reproduction of modules, preparations of learning packets, and distribution of learning packets continuously every week of the school year.

Although with its advantages, there were also cited numerous limitations on instructional materials, learning experiences, and teaching approaches. First, the instructional materials in this modality often lack high-quality or interactive content and lack real-life experiences. Second, the learning experience and success were contingent upon the high literacy or enjoyment of reading and were disadvantageous to struggling learners who learn best in other modalities. Third, the application of teaching approaches was often limited since the teaching responsibilities were handed over to the parents of the students. And last, the reproduction cost of printed modules if this pandemic and learning modality continues in the long run. It was a matter of truth that the modules were made of consumable materials mostly paper (Luz, 2020).

The introduction and use of the latest multimedia and information and communication technologies in the learning process is the most necessary aspect in the modern 21st century. Recently, it has been observed that the majority of the population quickly adapted to the use of advanced technologies in the field of education all around the world. Moreover, people started to use iPad, tablets, and devices

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for reading electronic learning materials as personal digital devices (Chiu, 2017). Sagdoldanova (2019) emphasized that e-learning materials such as e-books and e-module are the main educational learning materials created at a high scientific and methodological level designed primarily for the presentation of new information, supplementing print media, serving for individual and individualized training, and allowing to test the acquired knowledge and skills of a student to a limited extent. Given its tremendous use in the education field, e-learning modules could be a big help to teachers, students, and parents despite the COVID-19 pandemic. Marquez (2017) showed that using e-learning material, an up-to-date teaching tool, really enhanced students' academic performance. Moreover, the study showed that the use of such e-learning material was suggested to students with poor learning outcomes and it should be used in the most effective and efficient way to increase learning outcomes. Further, the study revealed that it was viewed as an instructional media to reinforce the teaching and learning process. Also, it served as a motivational device to help students upgrade themselves with modern trends that were suitable for them to increase their performance level (Aguilar, 2021).

In the Philippines, the Department of Education supported the idea of using e-books, e-modules, and other e-learning materials in the classrooms as presented in the Memorandum Order 105, series of 2009 which stated that as this country advances through the 21st century, the use of technology to research, organize, evaluate and communicate information had grown. It was the main reason why most schools, universities, and other educational institutions integrated the utilization of any e-learning materials as an educational tool that can provide opportunities to practice learning fundamentals in as many ways as

possible. It was widely used nowadays in different schools and institutions because lessons were installed on cellphones, computers, laptops, or tablets (Mercado, 2019).

With this, an e-module or electronic module was designed that served as a digital learning media device or non-printed that is constructed systematically for independent learning needs which demands the students to solve the problem in their way. (Jaenudin et al, 2017). Dimhad (2016) stated that an e-module is a part of electronic-based e-learning in which the learning utilizes information technology and communication, specifically electronic devices. Compared to a printed module was that its interactive term ease navigation, allowed the user to display/load images, audio, video, and animation as well as it is completed by a test/formative quiz that ensured automatic feedback immediately. (Suarsana et al, 2013).

Physics as a subject was commonly associated with complicated and difficult to master in schools. Some findings explained why students consider physics as a lesson that is difficult to understand because it requires memorization and contains mathematical elements (Samudra et al, 2014). This was also because the teacher did not display something interesting or eye-catching about physics when explaining the concept to the students. Students consider physics subject difficult because physics is a discipline that uses varied understanding methods, translates a sentence into another sentence, translates tables, graphs, equations, diagrams, and maps. In addition to strong basic concepts, physics is also a lesson that requires mathematical calculations to solve problems (Rivero, 2020).

Widyaningrum et al (2013) said that improving the quality of the learning process in schools can be done, one of which is the development of teaching materials. Teaching materials like printed modules had not been

maximized to meet the needs of the students and at the same time tend to be informative and less attractive which cannot display sound, video, animation, and images that can provide a clear explanation of the concepts conveyed (Darmaji et al, 2019). In today's technological development most students are more interested in teaching materials that utilize other media such as computers/laptops, even smartphones compared to teaching materials in the form of printed modules (Irwansyah et al, 2017). Therefore, it is necessary to modify printed modules in the form of an electrical module or an e-module by using one ICT product in the form of software or a program (Darmaji et al, 2019). In addition, the use of e-modules has the potential to change the views of students to read and consume interactively and make them comfortable, where the printed modules have images, narratives, and graphics but e-modules can contain various features such as audio, music, animation, and video (Nindy & Kustijono, 2017).

Converting printed modules to e-module was possible through Kotobee Author software. The e-modules using the Kotobee Author Software application have many benefits, which can be accessed offline or online via Smartphone or tablet. Teaching materials developed using information and communication technology products can stimulate students' thoughts, feelings, concerns, and interests in a more effective process. Learning uses technology through teaching materials can manage learning activities according to their flexible time and activities (Jaenudin et al, 2017).

The educational process is increasingly being transformed under the influence of new technologies provided and introduced in order to provide the skills and knowledge that will be in demand in the future in a constantly changing teaching and learning process. The learning process inside or outside of the classroom is becoming more dynamic which removes boring and monotonous delivery of the lesson. All of this happened due to gamification, personalization, and digitalization of the content.

The use of e-modules and other e-learning materials changed the function of the teacher, turning him from a translator of educational information into an organizer of the process management of an effective learning manager. Traditional textbooks and printed modules do not demonstrate the methods of active development of the presented educational information. In addition to information, e-learning materials include technologies for organizing productive cognitive activities that are placed in their methodological part in the form of didactic blocks where basic educational information and methods of studying and deepening it are combined. Overall, e-learning materials direct students to an independent educational search for self-control and self-assessment of knowledge (Sagdoldanova, 2019).

It was from this end that the researchers were challenged to develop an interactive e-module in supporting conceptual comprehension of Newton's Laws of Motion. The study would serve as data in strengthening the science curriculum and instruction with technology integration as an innovative strategy to be employed by teachers in teaching the subject.

2. Method
a. Research Design

This study employed descriptive and quantitative approaches with experimental research design. A quasi-experimental design was used to compare the students' physics comprehension using the developed e-module against the traditional printed module. Here, the experimental posttest control group design fits the scenario. Tests and treatments that

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were administered to each group were illustrated in Table 1.

Table 1. The Experimental Posttest And Control Group Design

Experimental (E)	$PreT_1$	X	$PostT_2$
Control (C)	$PreT_3$		$PostT_4$

Key:

    X – Treatment (E-learning module)
    PreT1 and PreT3 - Pretest
    PostT2 and PostT4 – Posttest

The experimental group had their learning experiences augmented by the e-learning module while the control group (C) was taught using the printed modules method of instruction.

Paired and Independent T-tests were used to determine the significant difference between the pretest and post-test of students using the e- modules and printed modules methods of instructions.

b. Participants of the Study

The participants of the study were Grade 8 students of Simbalan National High School currently enrolled in the school year 2020-2021. A total of seventy-eight Grade 8 students from four sections; 37 males and 41 females were the participants in the study.

Students were divided into two groups the controlled and experimental groups. The control group used the printed Grade 8 modules provided by the DepED, while the experimental group used the developed e-module made by the researcher. Displayed below were the participants of the study.

Table 2. Participants of the Study

Section	Method of Instruction	Sex		Age		
		Male	Female	13 YO	14 YO	15 YO
A	Experimental	9	11	8	12	0
B	Experimental	9	10	9	10	0
C	Controlled	10	10	8	11	1
D	Controlled	9	10	8	10	1
	Total (78)	37	41	33	43	2

c. Research Instrument

The instruments used were questionnaires to collect essential data for this study and the Kotobee Author software in the development of the e-learning module.

First, a test questionnaire consisted of 40 multiple choices used to determine the pretest and posttest scores of each student in the two groups. To ensure the validity of the instrument, it was submitted and checked by a group of experts.

Second, a survey questionnaire was used to determine the validity and acceptability of the developed e-learning module in terms of material worthiness, media feasibility, and language eligibility. The questionnaire was validated by three Science teachers, IT specialists of Agusan del Norte Division, and English teachers.

Third, the Kotobee Author v1.6.2 software was used in the development of the e-learning module on the topic of Newton's Laws of Motion. It is an easy-to-use tool for producing immersive e-books and digital publishing material both online and offline while maintaining its interactive features. Also, the Kotobee reader software was used to run the developed e-learning module.

The researchers also used the available 40 tablets in the school through an approval letter submitted to the Office of the Principal. This e-learning material was used by the

students who do not have the learning materials in the conduct of the study. Further, a waiver or a letter of agreement was signed by the students for them to be responsible for handling and taking care of the borrowed e-learning materials.

Moreover, to ensure the validity of the instruments, pilot testing was done on the students who were not the intended respondent of the study. During the pilot testing, the researcher observed some aspects to improve such as simplification of questions, time allotted to take the pretest and post-test, and the time it took the e-module to load and unload information.

d. Data Gathering Procedure

The researchers sent a letter to the Office of the Principal humbly seeking permission to properly conduct the study and administer the developed e-module to the selected Grade 8 students of Simbalan National High School. A letter of request was also sent to the Kotobee Author software developer team to allow the researcher to use the software in developing the electronic module to be used in the study.

Before the introduction of the e-module, the material undertook different stages namely: Planning, Development and Validation, and Implementation.

e. Scoring and Quantification of Data

Displayed in the table below was the mean percentage range of the participants with their corresponding verbal remarks.

Table 3. Interpretation on the Mean Score of the Participants

Mean Percentage Ranges	Verbal Remarks
96% - 100%	Mastered
86% - 95%	Closely Approximating Mastery
66% - 85%	Moving Towards Mastery
35% - 65%	Average Mastery

As shown in Table 3, students who had a mean percentage ranging from 96% - 100% had verbal remarks of Mastered, 86% - 95% was Closely Approximating Mastery, and 66% - 85% was interpreted as Moving Towards Mastery. Mean percentages of 35% - 65% had a verbal remarks of Average Mastery, 16% - 34% was Low Mastery, 5% -15% was Very Low Mastery and 0% - 4% interpreted as Low Mastery.

The above statistical method was used to evaluate and interpret the collected data. Verbal remarks ranging from 66% - 100% showed that the developed e-module helped improve students' academic performance while verbal remarks ranging from 0% - 65% were interpreted that the developed e-learning module was not valid or acceptable in improving and increasing their performance significantly. Thus, revision of the said module will again be suggested and conducted.

f. Treatment of Data

The data collected were tabulated and treated accordingly to the problems presented in this study. The statistical tools used in this study are weighted mean, t-test for paired samples, t-test for independent samples.

Prior to that, data cleaning was done through descriptive statistics by examining the valid N, skewness, maximum and minimum. When the data was cleaned, satisfying the assumptions of the statistical tools mentioned was considered. Upon data cleaning, it was observed that the performance of the two experimental groups $(\overline{x_{e_1}} =$

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$85.44, \overline{x_{e_2}} = 85.89, t = -0.348, p = 0.730$), and the two controlled groups ($\overline{x_{e_1}} = 80.68, \overline{x_{e_2}} = 81.53, t = -0.710, p = 0.482$) had no significant difference at all. Hence, t-test for independent samples comparing experimental and controlled groups was used in this study.

3. Result and Discussion

The Pre-test and Post-test Mean Scores of the students using Printed and E-module methods of instruction with its corresponding interpretation were presented in Table 4.

Table 4. Pre-Test and Post-Test Mean Scores of the Students Using Printed and E-module Method of Instruction.

Constructs	Pre-Test		Post-Test	
	Mean Score	Remarks	Mean Score	Remarks
Printed Module	36.4%	Average Mastery	47.2%	Average Mastery
E-Module	40.7%	Average Mastery	75.4%	Moving Towards Mastery

Shown in Table 4 were the pretest and posttest mean scores of the students using the printed and e-module method of instructions. The pre-test scores of the students in both the control (Printed Module) and experimental group (E-Module) had a remark of average mastery with a mean score of 36.4% and 40.7%, respectively. The post-test mean scores showed a large difference between the two groups as the students using printed modules remained at the average mastery level with a mean score of 47.2% while students taking the e-module were moving towards mastery with a mean score of 75.4%. This showed that the scores of the students in the post-test for the two groups improved and increased significantly. The pretest performance results further coincide with the study of Valencia (2020) revealed that the students did not have any idea of the subject matter yet. In addition, the students have not yet encountered such competency in any discussion or reference material.

Also, it can be reflected that students under the e-module had an improved performance compared to printed modules considering that the learning process was interactive and students learn best when they are directly involved in it. Students' retention of knowledge was best using the e-module because it helped and trained students to think analytically considering the level of competency being measured

Poldaas (2016) also found out that the majority of students believed that they can focus better on the course material, topic, or lesson, they remember it better if they read it in print, and they considered themselves to be more likely to review printed material. Also, Valencia (2020) concluded that the use of a module as a teaching tool claimed to be more adequate than traditional or conventional teaching with the respect to the quality of learning as it helped them improve their understanding of the subject matter.

Hill (2015) stated that designed e-learning modules used as pre-instruction can make a difference in students' conceptual understanding and representational fluency in physics, as well as make them more aware of their learning processes. Moreover, Isna (2017) concluded that the application of e-modules is highly recommended in physics learning since it can improve the students learning outcomes as well as their scientific attitudes. Additionally, Aribowo et al (2017) concluded that the use of e-modules in Basic Electronics significantly improved students' outcomes. The module was developed using a problem-solving approach directly train and

help students think critically and affect the improvement of students learning.

Using an e-module really improved learning more efficiently, effectively, and relevant. Serevina et al (2018) concluded that the physics e-module can improve students' critical thinking skills that demand students' independence to find a concept. It is also supported based on the results of research conducted by Febrianti et al (2017) which shows that the developed physics digital modules are suitable for use as self-learning materials for students or material on self-learning.

Similarly, the result supports the study of Ambayon (2020) where the modular-based worktext was effective in helping students improve academic achievements in Science. Accordingly, the module led to the accomplishment of the subject's basic goals, allows for the development of higher cognitive skills, is well-organized and well-designed, and is appropriate for the student's vocabulary level and performance. Also, Darmaji et al (2019) concluded that there were significant differences in the use of e-module in physics practicum with reflectance material on a flat mirror. The e-module used was more effective than using printed guidebooks.

Trilestari and Almunawaroh (2020) concluded that electronic modules could be one of the solutions for young learners to study at home. First, it provides digital teaching and learning materials and was compiled with interactive videos, recordings, pictures, and animations to improve the students' interest. Second, it could be used online and offline so that the students could study without facing the problems of signal and quota. Third, it helped students and teachers enrich their teaching and learning experience. Finally, it helped teachers manage their teaching materials and time because the materials are created based on the need/curriculum.

With the development of technology, print modules can be changed into more interactive electronic modules that were packaged in a digital format. This interactive electronic module can change the presentation of modules that were usually printed into modules that can be read without having to be printed by utilizing technological devices that have evolved. In consonance with this, Wijaya (2019) concluded that there is a significant difference between the use of printed modules and e-modules. Results showed that using interactive electronic module teaching materials effectively enhanced students' performance in the learning process, especially in educational innovation courses.

Furthermore, the developed e-module facilitated the learning process systematically. Teachers could easily manage the learning process in a lesser time with a maximum learning output. It is a matter of fact that invalid content and delivery of the topic cause misconceptions. These misconceptions lead students to have a wrong understanding of the material just like the printed modules. In other words, teachers could really benefit from introducing material with technology integration in teaching the subject. Moreover, it helped teachers cope with their teaching materials and time because the materials are made based on the competency being measured in an interactive way.

Overall, the use of electronic modules and printed modules can improve students' learning outcomes (Jaenudin, 2017).

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Table 5. T-test for Independent Samples on the Post-Test Mean Scores of the Participants

Constructs	Post-Test Mean Scores	Statistics	p-value	Remarks
Printed Module	47.2%	-21.84	0.000	Highly Significant
E-Module	75.4%			

To test that the posttests mean scores of the controlled group who used the printed module of instruction is statistically significantly different from the post-test mean scores of the experimental group who used the e-module method of instruction, an independent t-test analysis was performed. Prior to conducting the analysis, the assumptions of normally distributed differences and Cronbach's alpha results were examined. The assumption was considered satisfied, as the skew and kurtosis levels were less than the maximum allowable values for a t-test (i.e., </2.0/ and kurtosis </9.0/; Posten 1984).

Learning is best delivered when students are actively engaged in the learning process. It is a matter of fact that most students prefer to learn when the learning process is fun and interactive, thus, retention of learning is maximized. As can be seen in Table 5, the post-test scores of the two groups showed a highly significant difference. The printed module has a mean score in the post-test of 47.2% only while the e modules has a high mean score in the post-test of 75.4%, with a 95% confidence interval, the p-value is (α =.0.000) the value is lesser than 0.05, thus, the posttest mean scores of the controlled group who used printed modules is statistically significantly different to the posttest mean scores of the experimental group who used e-module method of instruction. This is further accompanied by the study of Hanif (2019) which showed that students who used the interactive e-module obtained superior learning outcomes than those who used printed materials. The results are also supported by the research from Candra &

Irianto (2016) which shows that the student's learning outcomes by applying the contextual learning model using e-modules are better than those by applying the contextual learning model using handouts.

The results above can also be associated with the study of Astuti, Siswandari, and Santoso (2017) stated that using e-module based on Problem Based Learning can improve the material understanding and mastery of competencies in the learning process to improve the students' learning outcomes to the full. The use of interactive teaching materials can significantly improve students' learning outcomes (Prihantana, Santyasa & Warpala (2014).

The result obtained can also be complemented in the study of Arysad (2016) stated that print modules tend to be monotonous and affect students' interest and enthusiasm for using them. In line with this, using e-modules in learning allows the students to have high speed in learning that can accomplish one or more basic competence quickly compared to other students who used printed modules. (Baedhowi et al, 2017). Therefore, the use of e-modules must be encouraged to students to help them develop good learning habits as it caters more to the multiple intelligences and individual differences of the learners.

a. On the Academic Performance in Pretest and Posttest of the Students in Using the Printed Module and the Use of E-Module

Displayed in Table 6 is the Paired T-test Analysis on the Pre-test and Post-test of the students using printed modules of instruction.

To test that the pretest scores (M = 36.4%) of the students using the printed module of instruction are statistically significantly different from their post-test (M = 47.2%) scores, a paired t-test analysis was performed. Prior to conducting the analysis, the assumptions of normally distributed difference and Cronbach's alpha results were examined. The assumption was considered satisfied, as the skew and kurtosis levels were less than the maximum allowable values for a t-test (i.e., </2.0/ and kurtosis </9.0/; Posten 1984).

Table 6. T-test for Paired Samples on the Pre-test and Post-test Scores of the Students Using Printed Modules

Constructs	Pre-Test	Post-Test	Statistics	P-value	Remarks
	Mean Scores				
Printed Module	36.4%	47.2%	-21.073	0.000	Highly Significant

As presented in Table 6, with a 95% confidence interval, the p-value is (α =.000), the value is lesser than 0.05, thus, pretest scores of the students using printed modules is statistically significantly different from their post-test scores. This may signify that the scores of the students were improved and increased significantly using the printed module method of instruction. Due to the COVID-19 pandemic, face-to-face class was prohibited which paved the way for using printed modules. Still, students had improved scores using printed modules at their own pace of learning. Printed modules aid students in understanding the concepts presented. The result obtained can be complemented in the study of Palsdottir and Einarsdottir (2016) said that most students claimed that they could focus better on printed material, remember it better, and were more likely to highlight, notate and review the text. It was also discussed in the study of Baron, Calixte, and Haywela (2017) that being able to scribble, underline and write down notes with the text while reading it, was considered essential to the students' learning strategies, as it helped them to focus on what they read, as well as to draw meaning out of it, and to remember it.

The results were also further reinforced by the study of Labis (2016) that interesting and concrete illustrations and simplified explanations of the topics in a module effectively aid the students in understanding the concepts taught. Thus, students find it easier to accomplish the activities or tasks as set in the modules.

Additionally, according to Valencia (2020) in her study "Modular Approach in Teaching Science 10, learning is facilitated when the student participates responsibly in the learning process. When the learner chooses his own directions, helps to discover his own learning resources, formulates his own problems, decides his own course of action, and lives with the consequences of these choices, then significant learning is maximized. Thus, the use of modular instruction allows the learners to discover patterns, be responsible for their own learning, as well as learn the new concepts presented to them. As a result, much significant learning is required.

Seen in Table 7 is the Paired T-test Analysis on the Pre-test and Post-test Scores of the students using the e-module method of instruction.

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Table 7. T-test for Paired Samples on the Pre-test and Post-test Scores of the Students Using E-modules

Constructs	Pre-Test	Post-Test	Statistics	P-value	Remarks
	Mean Scores				
E- Module	40.7%	75.4%	-54.721	0.000	Highly Significant

To test that the pretest scores (M = 40.7%) of the students using the electronic module method of instruction are statistically significantly different from their post-test (M = 75.4%) scores; a paired t-test analysis was performed. With the same assumptions to be considered, as shown in Table 7, with a 95% confidence interval (α=0.50) the value is lesser than 0.05, thus, the pretest scores of the students are statistically significantly different from their post-test scores. This signified that the scores of the students were improved and increased significantly using the electronic module method of instruction. This is in consonance to the study of Jaenudin (2017) in which she stated that e-module based problem-based learning is designed to help students in improving critical thinking skill, problem-solving and intellectual skills by experiencing it through the real or simulated situation as well as to become independent students so that learning achievement can be maximal.

In this time of pandemic, it cannot be denied the importance of e-modules which have a dominant and pivotal part in students' learning and performance. To improve the performance of the students, teachers must use effective methods, strategies, and approaches like technology integration to facilitate the teaching-learning process. In addition, e-modules are selected in the discharge of problems related to improving the quality of learning in the subjects of physics because they can facilitate communication between learners and educators, subject matter, and among fellow learners in terms of the situation, condition, time, or place (Darmaji et al, 2019). This is because learning with an e-module can not only be done during school hours but can also be outside school hours (Murai et al, 2016). Also, based on the research conducted by Perdana (2017) the use of E-Module can improve students' critical thinking skills and learning motivation.

Lastly, the use of e-modules can improve students' learning independence (Hapsari & Suyanto, 2016), learning outcome (Herawati & Muhtadi, 2018), critical thinking skills (Suarsana, 2013), and problem-solve (Utami et al, 2018). The use of e-modules in the learning process will foster creativity and productive thinking habits and create active, innovative, and enjoyable conditions in the learning process (Budiarti et al, 2016). Digital teaching materials will be needed to support student lecturing activities when teaching materials are not yet available. With electronic teaching materials, students will be more interested in independent learning.

b. On the Academic Performance of the Students in Posttest with the Use of Printed and E-Modules

Modular instructions like printed or electronic do help improve the performance of the students in the teaching and learning process. It is a matter of fact that both methods of instruction are beneficial especially during this time of crisis. In short, both modules whether printed or e-modules, contribute to the increase of the performance of the students.
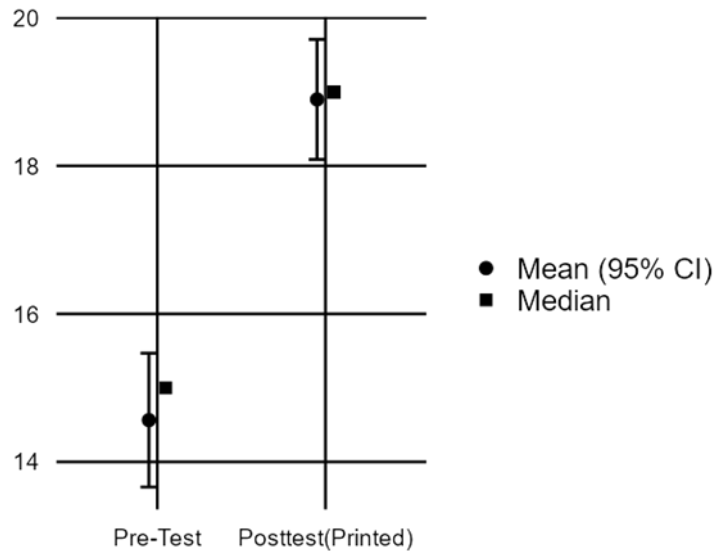
Figure 1. Gain Score Performance of the Students Using Printed Module

As can be viewed in Figure 1, students' pretest scores range between 13-16 points while their post-test scores range between 18-20 points. The letter "I" in the plot indicates the variation of the scores of the students. The longer the "I" the more varied the scores are, the shorter the "I" the lesser the variation of the scores are. It is also indicated in the plot above that those students who were using the printed modules showed a 10.8% increase in their posttest scores.

The findings implied that the students got better results after their exposure to the Modular Teaching Approach. This further showed that they had an improved performance considering that they learn the concepts independently. The results can be associated with the study of Torrefranca (2017) which she stated the implications for both theory and practice regarding the use of modules in classroom instruction and the teacher devising the modules. Modular instruction is effective in individualizing learning by allowing a student to achieve mastery of one unit of content before moving on to another. Moreover, since the mean post-test score is greater than the mean pre-test score, there is sufficient evidence to conclude that exposure to the instructional module generally brought about improvement in the knowledge of the students. The students were able to improve their performance with the teaching innovation introduced.

The results also further correspond to the study of Samson (2014) where the use of the Modular Approach in Science was remarkably beneficial even with less supervision from the teacher. It surpassed the performance of the students subjected to a conventional classroom that required the teacher's presence all the time. Still, printed modules improved students' learning outcomes even if it is not interactive. This is an advantage for those students who don't have gadgets and other e-learning materials. Also, it is vital even with less supervision from the teachers with the activities and concepts presented in the module are systematic and aligned to the desired learning competencies being measured.

The result is also supported based on the findings of the study by Valencia (2020) concluded that the Modular Approach as an alternative instructional method in teaching Science 10 significantly enhances the performance of the students. The findings of

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the study showed that the approach used appeared to be effective and exhibited a vital connection in improving students' academic achievement in Science 10 as supported and validated by Carl Roger's Facilitation Theory, Jerome Bruner's Constructivist Learning Theory, and Article XIV of the 1987 Philippine Constitution. Teachers relied heavily on using printed modules, especially where face-to-face classes were prohibited. Students were provided learning materials that aid and help them face the trend of the ongoing pandemic. Further, it helped teachers and students communicate the findings and results in designing and crafting a well-developed module.

Presented in Figure 2 below were students' pretest scores ranging between 16-18 points and their post-test scores range between 29-32 points. The letter "I" in the plot indicates the variation of the scores of the students. The longer the "I" the more varied the scores are, the shorter the "I" the lesser the variation of the scores are. It also indicated in the plot above that those students who were using the electronic modules showed a 34.7% increase in their posttest scores.
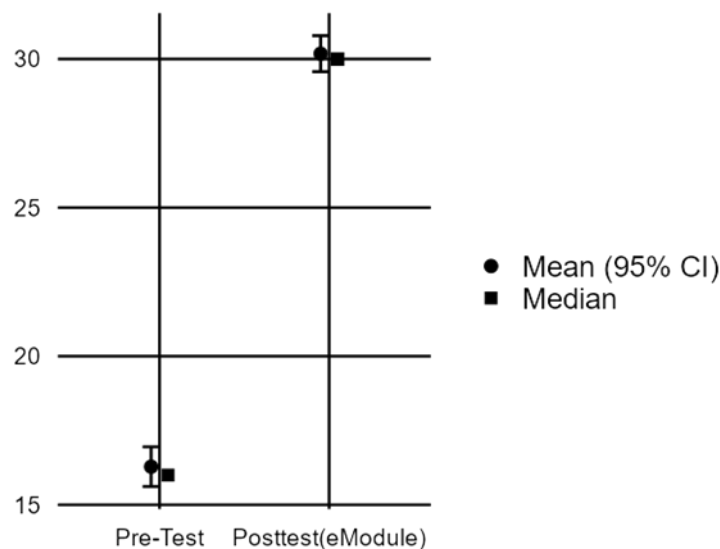

Figure 2. Gain Score Performance of the Students Using Electronic Module

The data implied that Electronic Module Learning Approach significantly improved the performance of the students in learning science concepts based on the competencies measured. It was evident from the results above that the use of electronic modules greatly affects students' learning because it enabled the learners to achieve improved performance in Science 8. Students found it stimulating and challenging as they were motivated, driven, and involved actively in the various activities presented in the developed interactive electronic module. The results are consistent with the study conducted by Hanif (2019) that the use of interactive teaching materials can significantly improve the students' learning outcomes. In addition, Hasbiyati and Khusnah (2017) also revealed that the electronic module implementation with the "epub" extension can increase the learning interest very well by 88.61% and can improve the students' learning outcomes with the high criterion in the form of a gain score of 0.703

in the junior high school science learning. This is also supported based on the results of the research conducted by Febrianti (2017) which shows that the developed physics digital modules are suitable for use as self-learning materials for students.

A coherent study by Sugiani (2019) claimed that the use of the electronic module is very effective to improve the learning outcomes of the students in learning science concepts. Additionally, Riana (2016) suggests that electronic modules with a multimedia approach help learners to better understand the content of learning. Some of the students found the e-module challenging and stimulating where it promoted higher order thinking skills. They agreed that the developed e-module helped them improve their performance in the topic presented.

Also, teachers can easily spread and give the e-learning material as it is hand-carried, hassle-free and the concepts given were systematic and interactive.

Nurhasnah (2020) stated that the effort to realize the learning of physics that can support the independence of students' learning can be done by developing digital teaching materials that utilize technology and communication. In connection to this, Kowitlawakul (2017) stressed that the use of digital teaching materials in the learning process is one of the efforts to create more meaningful and quality learning and interesting, effective, and innovative learning.

Displayed in Table 8 is the comparison of the gain score performance or improvement of the students using printed and e-module method of instruction.

Table 8. Gain Score Performance or Improvement of Students Using Printed Module and E-Module

Constructs	Pre-Test	Post-Test	Improvement / Gain Score
Printed Module	36.4%	47.2%	10.8%
E-Module	40.7%	75.4%	34.7%

Table 8 showed that there was an improvement and gain score in the two groups. The control group under the printed modules have a pre-test score of 36.4% and got a post-test score of 47.2%. Students under the control group got a slight improvement of 10.8%. The pre-test scores of the experimental group using the e-module got a score of 40.7% with a high score in the post-test which is 75.4%. The e-module group got an improvement score of 34.7%. The results were supported by the study of Nindy and Kustijono (2017) stated that the use of e-modules has the potential to change the views of students in the learning process to read and consume interactively and make them comfortable, where the printed modules have images, narratives, and graphics but e-modules can contain various features such as

audio, music, animation, and video which makes and helps students learn concepts at their best.

Additionally, Rivero (2020) stressed that students consider physics subject difficult because some teachers do not display something interesting or eye-catching when explaining the concept. In consonance with this, Dimhad (2016) pointed out that compared to the printed module, the e-module has the advantage in terms of its interactive term ease of navigation, which allow the user to display/load images, audio, video, and animation as well as it is completed by test/formative quiz that allows automatic feedback of the progress of the educational process.

The results were also supported by the study of Linda et al (2019) which concluded

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that the implementation of the interactive chemistry e-module based on Kvisoft Flipbook Maker on Stoichiometry can improve student self-learning with 4 indicators such as self-confidence, high motivation, initiative, and responsibility. The results showed an increase in students' self-learning process before and after the use of e-module which is from 50.15% to 88.1%. The magnitude of increase obtained by the N-Gain test that is 0.76, which means the student self-learning was increasing in medium category.

Additionally, Zia et al (2018) concluded that the use of e-modules statistically helped improve students' performance in Physics with the topic Heat and Temperature. This is seen from the results of the initial test students obtained averaging 40.83 while the final test of students using electronic module obtained 79.50, while the average results of learning outcomes of learners to obtain N-gain score of 0.66 are included in the medium category.

Using the electronic module is very helpful in the learning process. Daniel (2015) in his research suggests that the modules are effectively used in E-learning. The use of modules is very interesting for learners in the learning process. Budi and Citrawati (2017) argued that the question-based inquiry module (QBIM) is effectively developed to facilitate science learning to improve the mastery of biology concepts, science process skills, and the learner's thinking abilities. Sogiani, et al (2019) in their research suggests that E-modules with a multimedia approach help learners to better understand the content of learning thus improving their performance and learning outcomes.

Further, Zia (2018) stated that a good electronic physics module provides benefits for learners, such benefits can provide convenience to learners to understand the concepts of physics and relate learning physics in everyday life, and can be used as a variety of teaching materials that can encourage learners to learn independently, creatively, and effectively in the process of learning to achieve mastery of competence, so that learners' learning outcomes in accordance with the expected.

Overall, both methods of instruction significantly improved the performance of the students. However, as shown in the plots and tables, students under the e-module increased largely and improved with higher points compared to those who were using the printed modules. Also, compared to printed modules the developed e-module really helped improved their performance as it was found out interactive and challenging. It is a matter of fact that students under the e-module agreed to the idea that using it promoted higher order thinking skills which helped them easily understand the ideas and concepts given. Similarly, teachers can easily promote this kind of teaching strategy in their class as it is an additional learning activity to be provided to enhance and develop the thinking ability and skills of the learners.

c. On the Validity of the Developed Interactive E-Module

The material worthiness validation of the developed interactive e-module to support students' conceptual comprehension of Newton's Laws of Motion is presented in Table 9.

Table 9. Material Worthiness Validation of the Developed Interactive E-module

Indicators	Means Score	Remarks
Content is suitable to the student's level of development	5	Strongly Agree
Instructional design of the material facilitates understanding of concepts presented	5	Strongly Agree
Material is free of ideological, cultural, religious, racial, and gender biases and prejudices	5	Strongly Agree
The presentation is engaging, interesting, and understandable	5	Strongly Agree
There is a logical and smooth flow of ideas	5	Strongly Agree
Visuals are relevant to the text and suitable to the interests of the target user	5	Strongly Agree
Visuals are clear in content and detail	5	Strongly Agree
The material is adequate to master the competencies and reinforce learning	5	Strongly Agree
The material activities have a purpose and are aligned to a skill or concept of the grade level	5	Strongly Agree
The material used contributes to easy reading and is durable	5	Strongly Agree

Range of means: 1.00-1.80 (Strongly Disagree); 1.81-2.60 (Disagree); 2.61-3.40 (Uncertain); 3.41-4.20 (Agree); 4.20-5.00 (Strongly Agree)

In terms of material worthiness, the evaluators gave a strongly agreed remark with a perfect rate of 5. This indicates that they both agreed that the contents of the developed interactive e-module were within the criteria set for evaluating its validity. The e-module design fitted for the needs, interests, and abilities of the learners. Moreover, having material worthiness denotes that we must be able to obtain the necessary information and details. The results find support from the study of Wahyuni, et.al (2018) that the aspects of content eligibility include the suitability of the material contained in e- modules and the purpose of learning and materials provided according to the ability of learners. The validity of the content material is vital and necessary in the teaching-learning process to ensure the desired competencies being measured. It is a fact that most students find science concepts difficult to understand. Misunderstanding among students arises when the concepts are not properly explained. The developed e-module would really help the teachers especially when a classroom has a great number of learners, learning is difficult to achieve and hardly monitored.

The results were also supported by the study of Ramirez and Mercado (2019) that among the features for selecting and integrating world-wide-web resources was content. The content must clearly state the objectives or competencies that can be used for various learning styles and intelligence and at the same time information must be current and accurate. In addition, the content of the instructional materials should be the anchor to the national and local standards and benchmarks of the curriculum. The content should be based on the Philippine Secondary Learning Competencies. The author cited that choosing the instructional material in teaching requires a lot of thinking and decision-making and must be clearly defined for the students to grasp.

Likewise, Nurhasnah, Aswirna, and Abshary's (2020) misconceptions can lead to obstruction of understanding and assimilation of knowledge gained by students so it becomes a barrier for students in achieving their learning goals. In designing an e-module, teachers should arrange the elements starting from the aims and learning outcomes, course content, teaching methods and resources, assessment or exercise,

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monitoring, and review. Trilestari and Almunawaroh (2020) stated that learning objectives and outcomes should be obvious and reachable which is aligned with teaching activity and assessment. Before creating an electronic module, it is important for educators to arrange the materials to be taught for young learners in the form of soft files. Further, Ambayon (2020) explains that the course embraces modules for the students, the modules should link unswervingly with the main text and have drills that match with the lessons. The activities in the modules should be thought-provoking for the students and should be able to aid you, as a teacher evaluate where they are, as far as how well they have immersed in the material and whether there is a need to review the lessons again with them.

A module is systematic and compelling teaching material that includes material, method, and evaluation content that can be used independently. In connection to this, Sudarmin (2016) pointed out that the contents of a module should be complete, either viewed from the pattern of the dish, let alone the contents. The module should be compiled based on problem analysis and requirements analysis, then validated against the validation of content, language, and display module substance additives based ethnoscience. Similarly, Tan-Espinar and Ballado (2017) also validated a module in Mathematics that has boosted the students' independent learning. They further underscored that a module must be acceptable, and the contents are valid. Also, Reyes and De Guia (2017) stressed that a module must obtain a high acceptability rating as evidence of content validity and relevance. Hence, it may include but is not limited to highly acceptable content, clarity, appeal, and originality.

The validity of the content is a very important part of module development. This is because the content in the module becomes a reference in learning activities for teachers and students. Invalid content can cause misconceptions. This misconception causes teachers and students to have a wrong understanding of the material. That is why the development of an e-module should be validated specifically on its content.

The media feasibility validation of the developed interactive e-module to support students' conceptual comprehension of Newton's Laws of Motion is shown in Table 10.

Table 10. Media Feasibility Validation of the Developed Interactive E-module

Indicators	Means Score	Remarks
The material's non-text content (graphs, tables, pictures) is accurate and well-integrated into the text	4.67	Strongly Agree
Easy to navigate the pages	5.00	Strongly Agree
Accessible lessons through hyperlink text in the table of contents	4.67	Strongly Agree
The material contains engaging interactive visual features	5.00	Strongly Agree
The material has neat and interactive graphics	5.00	Strongly Agree
Sustains the attention and interest of the learners	5.00	Strongly Agree
Appropriate for the level of understanding of the learners	5.00	Strongly Agree
The material uses varying fonts and sizes	4.67	Strongly Agree
The material uses contrasting colors for easy reading	5.00	Strongly Agree
The material has a format that is visually appealing and interesting	4.67	Strongly Agree

Range of means: 1.00-1.80 (Strongly Disagree); 1.81-2.60 (Disagree); 2.61-3.40 (Uncertain); 3.41-4.20 (Agree); 4.20-5.00 (Strongly Agree).

The evaluators gave strongly agree remarks with a rate of 4.9 on media feasibility. The remarks indicate that the tool is said to be credible to potential teachers and institutions,

its perceived objectivity must be high. This could also mean that the aspects of the developed e-module in terms of its features, design, graphics, text, image, layout, controls, and other media contents were useful, interactive, and meaningful. This is supported by the study of Bishnoi (2020) concluded that the significance of visual design should be considered in developing electronic modules in terms of its navigation, accessibility, interactivity, self-assessment, and learnability. In line with this, Yazid (2016) stated that aspects of media feasibility include ease of access, use of letters, color composition, animation, and display design. Also, it could be noted that the validators strongly agreed that the graphics of the developed interactive module used contrasting colors for easy reading. This result conforms to the idea of Mercado and Ramirez (2020) that reading devices provide adjustable backlighting which enables users to read comfortably in poor lighting conditions, even in bed at night. It is significant, especially in this time of pandemic when students are most likely to review nighttime what they learn from the material and can maximize their learning time.

Furthermore, the use of different fonts and sizes was strongly agreed upon by the validators this implies that the e-module has varying fonts and sizes which help students to adjust based on their preferences. This conforms to the statement of Larson (2015) that e-module design should base on the suitability, objectivity, and usability of the learners, engaging process is fun due to its attractive features such as user-friendly functions, attractive graphics, enlarged text size, and plug-in speakers. These features would encourage students' creativity and learning autonomy. In addition, Hamid, Yuliawati, and Aribowo (2020) stated that students easily understand the concept of selection with visualization. Studying text material is more effective if it is equipped with graphics, animations, or videos for students to learn. Multimedia, especially visualization, increases student motivation in learning algorithms and coding. Likewise, Gabor (2020) concluded that learners retain new knowledge better when the curriculum was presented with a combination of formats of text, sound, graphics, and video and using a computer as a method of instruction Finally, Marzuki, and Triana (2019) stressed that the efficiency of media usage time is the use of e-modules more efficient with the time associated with no need for learners to record the explanation of educators because e-module physics has been equipped with a complete material description.

Overall, compared to printed modules, e-modules can be enhanced with other electronic features such as hyperlinks, videos, games, and other interactive assets of an e-module. Teachers can modify the topics and concepts in a systematic way which effectively boosts students' interest and involvement in the teaching and learning process.

The language eligibility validation of the developed interactive e-module to support students' conceptual comprehension of Newton's Laws of Motion is displayed in Table 11.

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Table 11. Language Eligibility Validation of the Developed Interactive E-module

Indicators	Means Score	Remarks
Language is appropriate for the level of the target user	5	Strongly Agree
Vocabulary level is adapted to the target reader's experience and understanding	5	Strongly Agree
The length of sentences is suited to the comprehension level of the target reader	5	Strongly Agree
Sentences and paragraph structure are varied and interesting to the target reader	5	Strongly Agree
Vocabulary used is suitable for the target reader	5	Strongly Agree
The material does not need special provisions to the extent that the student is uncomfortable with the unfamiliar words	5	Strongly Agree
The material choice of words is free from ambiguity	5	Strongly Agree
There is little or no help or assistance needed from the teacher in terms of language confusion	5	Strongly Agree
The material is free from red flags on possible copyright and plagiarism issues	5	Strongly Agree
The material does not need language/word corrections	5	Strongly Agree

Range of means: 1.00-1.80 (Strongly Disagree); 1.81-2.60(Disagree); 2.61-3.40 (Uncertain); 3.41-4.20 (Agree); 4.20-5.00 (Strongly Agree).

The language eligibility still has strongly agreed on remarks from the evaluator with a rate of 5. This indicates that the use of language in the developed interactive e-module was following the rules of good and correct grammar. In connection with this, Setiadi (2016) said that the use of good and correct grammar is important to send the right message. Grammatical errors can lead to misconceptions and/or give ambiguous meanings. Further, Gabor (2020) a module should be readable that create a warm and friendly atmosphere. Using familiar words (be precise and specific in writing) and strong action verbs helps a lot. The text should be plain, simple, and direct. This simply means that the developed module should be free from any grammatical errors and word corrections to avoid confusion on the part of the students. In connection with this, Nurhasnah, Aswirna, and Abshary (2020) concluded that grammatical errors and misconceptions can hinder the achievement of learning objectives. In short, words and sentence structures must be solid and clear without causing misconceptions and ambiguity.

Cheng (2018) suggested that teachers should set up their own materials based on the young learners' needs, language level, and ability. The module is agreed upon by educators as a useful and very helpful resource book. To avoid the high understanding and misconception of the materials, especially for young learners, teachers should create materials that could attract the students' interest by using audio-visual materials and interactive learning. Wijaya (2019) pointed out that modules are teaching materials that are arranged systematically, with language that is easily understood by students according to their level of knowledge and age, so that students, in this case, are students able to learn independently.

Also, it is very important to consider the use of language in developing an e-module. The use of language must be according to the level of knowledge of the students to avoid misconceptions. Furthermore, teachers must bear in mind that developing an e-module must be free of grammatical errors and use familiar words. In this way, students will be motivated and inspired by using it. In short, modules must be made using language that is

appropriate to the age level of students who use it.

Overall, the contents and aspects of the developed interactive e-module using Kotobee Author software met the criteria set for evaluating its validity. The e-module had engaging and interactive visual features to support students' conceptual comprehension of Newton's Laws of Motion.

4. Conclusion

The findings of the study led to the conclusion that both modules whether printed or e-modules, do contribute to the increase in the performance of the students. However, students under the e-module increased largely and improved with higher points compared to those who were using the printed modules. The novelty of research and development carried out was by developing an e-module using Kotobee Author, the results of the study were classified as valid, practical, and effective in supporting students' performance and independence in learning. This was based on the validation starting from content worthiness, media feasibility, and language eligibility. This simply means that the developed e-module was feasible and can be used as a learning resource supporting students' conceptual comprehension in learning. Further, the result of the study encourages teachers and stakeholders the integration of technology and other e-learning materials in the teaching and learning process to develop an interacting and inspiring learning environment as well as improve retention and knowledge transfer by learners. Additionally, using an e-module as an alternative e-learning material helps reduce the gap in the quality of education of students with high or low performance in the class. Developing such e-learning material is very important to address the needs and challenges

of today's educational system ensuring the DepED statement: "Sulong Edukalidad".

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