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CinQASE E-module: Its Effectiveness to Improve Senior High School Students' Physics Learning Outcomes

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Abstract: One of the many digital technologies to actualize the digital learning environment is to provide e-modules based on collaboration in questioning, analyzing, synthesizing, and evaluating (*CinQASE*) learning model. The main purpose of this study was to analyze the effectiveness of the *CinQASE* e-module to improve students' learning outcomes in 10th grade in several Senior High Schools in Kendari, Southeast Sulawesi Province. This study implemented design-based research with a three-group pretest-posttest design. 85 students in the 10th grade participated in this study. The research subjects consist of three classes. Each class will use the *CinQASE* e-modules with different concepts. These concepts were Work and Energy, Momentum and Impulse, and Circular Motion. The differences in learning outcomes will be tested and evaluated based on the t-test. The results of the data analysis showed the normalized gain in the medium category, and the differences in learning outcomes showed a significance level (0.000) < 0.05 for all classes. Consistently implementing the *CinQASE* e-module can improve physics learning outcomes for all class groups with Sig. (0.161) > 5%. Hence, the *CinQASE* e-module had the potential to be used in physics classrooms and improve senior high school students' learning outcomes.

Keywords: E-module; CinQASE learning model; Physics learning outcomes

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Introduction

Submission of information is essential to form students' thinking patterns about a physics concept. Materials that are easy to understand and attractively packaged will increase someone's interest in learning it and emphasize students' engagement in inquiry practices and pursue a career in the science-related field (Dwijayani, 2019; Jack & Lin, 2017). Therefore, it is hoped that the material presented must be packaged as attractively as possible, easy to understand, and of course easy to read. Offering interesting material, no matter how difficult the concept is if packaged attractively, easy to read and understand, the students will make greater encouraged to study after the lesson and not feel bored (Dewi & Lestari, 2020; Morris & Lambe, 2017). Besides that, the education-technology relationship describes how technology can shape the educational process and reintroduces the importance of 'technology' in education (An & Oliver, 2021). The human-technology relationship can change the focus of educational design so that technology is not only seen as a tool but become something 'useful' and could sense most of the cognitive scaffolding for the educational needs of society using ICT in a globalized digital age (Hou et al., 2021; Lawrence & Tar, 2018).

The development of e-book technology facilitates the combination of printing and computer technologies in learning activities, including modules. The module's presentation may be converted into digital form. The e-

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module was made to be able to operate independently by the students to prepare them better to learn independently (Logan et al., 2021). Electronic modules are electronic textbooks designed by teachers with the aim that students can study independently under the guidance of teachers systematically (Magdalena et al., 2021). E-modules are needed in learning activities that require students to explore independently, specifically during the pandemic, which eliminates direct interaction among students and teachers during the learning process.

The previous research reported that e-module can serve as a source of interactive learning and facilitate an effective learning process. (Ghaem Sigarchian et al., 2018). However, there are not many e-modules available, so they cannot facilitate students to learn independently. In addition, the module among students primarily still uses a simple illustrated print module and contains only practice questions. Therefore, even though many students have not been able to learn independently by using the print module without the help of a teacher, it is challenging to develop their knowledge. Furthermore, in the print module, there is no moving animation, video, or audio, so learning is not exciting and more monotonous. In contrast, e-modules display text and images and display moving animations, videos, and audio that can make learning more engaging, varied, and not dull.

On the other hand, students' learning outcomes are still not satisfying, which are the fundamental problems of students, are influenced by two factors, namely the teacher and the students themselves. The main thing that gets more attention in class is that students must be active during learning and find the concepts themselves. Therefore, efforts are needed so that the learning process does not run passively, for example, by applying the current demands of education in the 21st-century era. To meet the demands of the 21st century, the government changes and updates the curriculum used in learning, namely the 2013 Curriculum. One alternative learning model that teachers can use in the 21st-century learning process is the Collaborative in Questioning, Analyzing, Synthesizing, and Evaluating (*CinQASE*) learning model (Hunaidah et al., 2018).

The *CinQASE* learning model is a learning model that can increase students' creativity and innovation. Innovative ability is an ability that students must possess because this ability is essential to support the physics learning process. It is because the design of certain stages can reflect the active participation of students in the learning process and can be developed to the fullest (Hunaidah et al., 2018). Collaboration and cooperation encourage the development of critical thinking as the students' general competencies through clarification, discussion and sharing, and evaluation (Ab Kadir, 2018; Gokhale, 1995; Loes & Pascarella, 2017). Convincing evidence shows that collaborative groups have higher critical thinking skills and longer information retention times than learners who learn quietly as individuals. However, collaboration can be challenging for a student who learns in a group, the teacher must provide scaffolding (Näykki et al., 2021) to help them mastery the concept.

Recently, many learning aids have used electronic media, such as ICT technology, multimedia technology, television technology, and computer technology. However, there are not many learning modules that utilize electronic media in their use until now. Even though the use of electronic multimedia at the orientation phase will exceptionally improve the effectiveness of the teaching method and the delivery of lesson content, one alternative software used in making e-modules is Flip PDF Professional.

Flip PDF Professional software is software used to convert PDF files into digital flipping pages that allow us to create engaging and interactive learning content with several features supported by the software. Flip PDF Professional is different from the usual PDF format files we use. The Flip PDF Professional view is like an e-book view that can be flipped while reading it. The advantage of this software is that it is more practical because it looks in the form of an e-book and can be used directly on a PC desktop, tablet, or smartphone with Windows OS, iOS, or Android OS.

Derived from the survey made in several Senior High Schools in the Kendari city, we found that most of the obstacles teachers face were the limitation of books provided by schools, mainly physics textbooks. Therefore, the use of e-modules has been used, and it's just that the modules provided are still in PDF format, only in the form of text and images, so that students tend to get bored more quickly in the learning process. In addition, students have not been able to learn independently by using e-modules without help from the teacher. Hence, it is challenging to solve problems and develop the knowledge had by these students. Many students admit that physics is a complicated and less exciting subject because, according to them, the lesson absorbs a lot of energy to think, and the concepts learned are abstract.

Method

This research method is the quantitative method with three group pretest-posttest design. This research was conducted according to the principles of a natural classroom setting (Mahdiannur & Romadhoni, 2020), with some intervention using the *CinQASE* learning model and e-modules. The research design is presented in Table 1.

Table 1. Research Design of Three Group Pretest-Posttest

Subject	Pretest	Intervention	Posttest
A	O_1	X_1	O_4
B	O_2	X_2	O_5
C	O_3	X_3	O_6

Note:
O_1 : Pretest on the first subject class
O_2 : Pretest on the second subject class
O_3 : Pretest on the third subject class
O_4 : Posttest on the first subject class
O_5 : Posttest on the second subject class
O_6 : Posttest on the third subject class
X_1 : The intervention of *CinCASE* e-module #1 in the first subject class
X_2 : The intervention of *CinCASE* e-module #2 in the second subject class
X_3 : The intervention of *CinCASE* e-module #3 in the third subject class

This study uses three classes as research subjects. Each class consists of 25-30 students as participants. The three classes will use e-modules with the *CinQASE* model with different concepts. The total research subjects were 85 students in 10th-grade of Senior High School studying the concepts of Work and Energy, Momentum and Impulse, and Circular Motion. Each participant in this research has given consent. In addition, all data and the identity of each participant will be kept confidential and written anonymously according to the research ethics code.

The collecting data technique on students' learning outcomes is through a written test instrument. The instrument used in this study was a multiple-choice question. The data collection procedure was carried out by giving pre-test questions to students before the learning process took place. After the learning process using the *CinQASE* e-module took place, students were given a post-test. The data analysis technique in this study used the normalized gain (N-gain) equation, normality test, homogeneity test, and t-test. The data obtained in this study used SPSS software version 25 for Windows. The interpretation of N-gain is by the criteria according to Hake (1998) according to Table 2.

Table 2. Normalized Gain (<*g*>) Criteria

Score Interval	Criteria
$\langle g \rangle \geq 0.7$	High
$0.3 \leq \langle g \rangle < 0.7$	Medium
$\langle g \rangle < 0.3$	Low

The *CinQASE* learning model e-module with flip PDF professional software is effective if the minimum N-gain value indicates the medium category. The t-test suggests a significant difference between the students' pretest and post-test. Before the t-test calculation, the normality test was first performed if the test results show that the data is normally distributed, the analysis uses a paired sample t-test. Guidelines for decision making by taking the significance level of 5% in the SPSS 25.0 for windows program. The test criteria are: (1) The significance value (Sig.) < 0.05, the distribution is not normal; (2) The significance value (Sig.) ≥ 0.05, normal distribution. As for the homogeneity test, the test criteria are: (1) The significance value (Sig.) < 0.05, the data is not homogeneous; (2) The significance value (Sig.) ≥ 0.05, homogeneous data.

Result and Discussion

The CinQASE E-module Content Activities

E-module designed with Flip PDF Professional is beneficial in transforming print modules into interactive digital modules. The criteria for compiling learning activities in e-modules refer to three parameters: the format, content, and syntax of the *CinQASE* model (Hunaidah et al., 2022; Hunaidah et al., 2018; Wilson et al., 2003). The design of the *CinQASE* e-module content activity design used in the intervention is described as follows:

1. Cover

The front cover of the *CinQASE* e-module consists of the title of the teaching material that matches the material, the name of the developer, the appropriate image, and a statement that the *CinQASE* e-module is used for 10th-grade Senior High School students (Figure 1).

Figure 1. E-module Front Cover

2. Foreword and Table of Contents

The foreword is a description written by the author of the teaching materials, which includes the background of the preparation of e-module teaching materials, the authors' expectations, and thanks to all those who have assisted the author in the preparation of the *CinQASE* e-module made with Flip PDF Professional. In contrast, the table of contents contains a list of pages and the entire section of the *CinQASE* e-

module as teaching materials. The parts of the teaching materials presented in the table of contents are the foreword, table of contents, glossary, concept map, introduction, 1st learning activity, and 2nd learning activity, summary, evaluation, and bibliography (Figure 2).

Figure 2. Preface and Table of Contents of the E-module

3. Glossary and Concept Map

The glossary is a list of complex terms for students accompanied by the meaning of the material. This glossary aims to make it easier for students to understand the material. There are several terms for complex e-module teaching materials and components of questioning, analyzing, synthesizing, and evaluating so that they are presented in the glossary. The concept map contains a chart of the material to be studied. Concept maps can also help users of e-module teaching materials to understand the learning materials. To make it more straightforward, the following is a picture of the concept map that has been described (Figure 3).

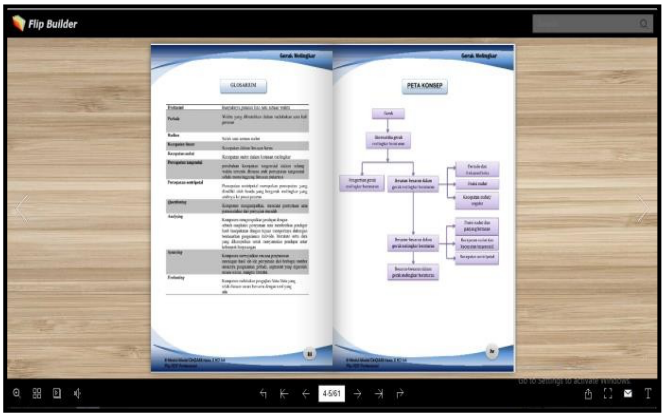

Figure 3. Glossary and E-Module Concept Map
Introduction and Instructions for Users

The introduction contains the *CinQASE* e-module's identity, the e-module, Core Competencies, Basic Competencies, a brief description of the material, and instructions for using the e-module. In addition, the instructions for using the e-module have a description of the components in the teaching materials to make it easier for users of the *CinQASE* e-module (Figure 4).

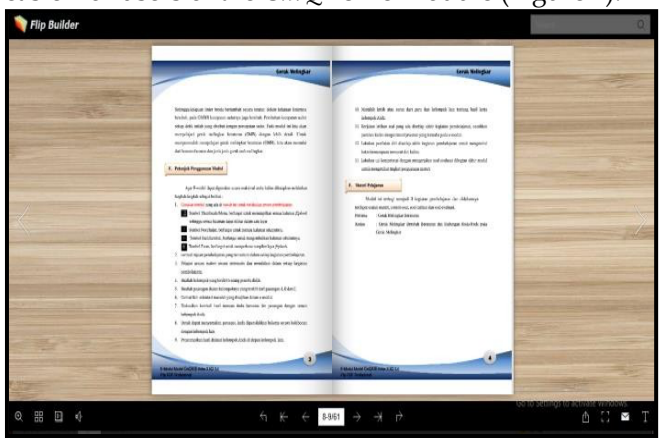

Figure 4. Introduction and Instructions for Users

4. Learning Objectives

This section presents the learning objectives to be achieved after using this e-module. After the learning objectives page is given, the learning material is shown to students in the *CinQASE* e-module, including the phases of the *CinQASE* learning model (Figure 5).

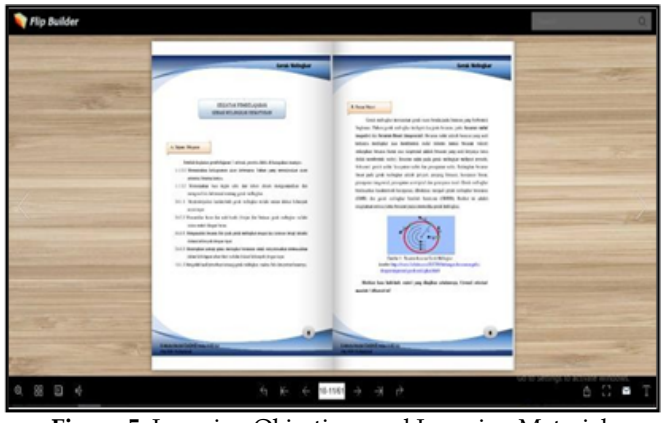

Figure 5. Learning Objectives and Learning Materials

5. Learning Activities

The learning activity contains activities that students must carry out to deepen their understanding of the learning materials (Figure 6). Activities in e-module teaching materials are how students solve a given problem by doing individual assignments or group assignments that have been given. The activities section in the e-module is equipped with various multimedia supporting the learning process. Multiple forms of learning modes are presented in video, audio, images, hyperlinks, and simulations. Applications to create e-modules make it possible to develop e-modules that meet interactive multimedia elements and can be opened on various devices (Glackin et al., 2014; Karakoç Öztürk, 2021; Martinez-Estrada & Conaway, 2012; van der Velde & Ernst, 2009).

Figure 6. Learning Activities in E-modules based on the *CinQASE* Model

6. Summary

The summary contains a brief explanation of the entire learning material, making it easier for students to remember the essence of the material studied (Figure 7).

Figure 7. E-module Summary

7. Evaluation

The evaluation contains questions based on the learning materials in the *CinQASE* e-module. Questions are arranged in the form of multiple-choice (Figure 8).

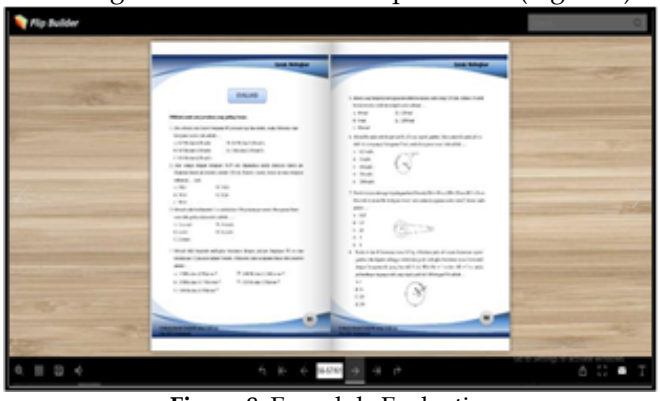

Figure 8. E-module Evaluation

The *CinQASE* e-module, which contains eight features, is expected to help the learning process. All components and interactive multimedia contained in the e-module are designed to increase understanding of concepts, increase student attention, and support learning outcomes (Alhammad & Ku, 2019; Asrowi et al., 2019; Morris & Lambe, 2017).

Intervention in Classroom using CinQASE E-module

Effective learning is needed to be able to develop student potential. Education will be effective if students feel happy, comfortable, and enjoy the lesson and are supported by good planning by the teacher, one of which is the selection of suitable teaching materials (Wulandari et al., 2020). The aim is not to improve student competence and learning outcomes. One of the effective teaching materials is the e-module. The effectiveness of the e-module can be seen based on the learning outcomes obtained by the students. We can infer the student's learning outcomes based on pretest and posttest. Based upon the outcomes of the N-gain, pretest, and posttest analysis in three classes using the *CinQASE* e-module, the results were entirely satisfactory. The prerequisite tests for normality and homogeneity of data distribution are presented in Table 3.

Table 3. Prerequisite Test Results for Student Learning Outcomes

Class	N-gain	Normality	Homogeneity
A	0.61 (Medium)	Normal Pretest: Sig.: 0.160 Posttest Sig.: 0.140	Homogeneous Sig: 0.196
B	0.62 (Medium)	Normal Pretest: Sig.: 0.116 Posttest Sig.: 0.080	Homogeneous Sig: 0.205
C	0.57 (Medium)	Normal Pretest: Sig.: 0.276 Posttest Sig.: 0.084	Homogeneous Sig: 0.083

Table 3 shows an increase in learning outcomes based on the test outcomes. To test the significance of the gain, we conducted the paired sample t-test value. Table 3 shows the normality test results for classes A, B, and C, which are declared to be normally distributed. This result is indicated by the significance value of the normality test for the pretest and posttest values in all classes > 0.05. Based on the criteria for concluding the normality test, if the value of Sig. ≥ 0.05, then H_0 is rejected, accept Ha that the data is normally distributed. The homogeneity test of the research data presented in Table 3 shows that the pretest and posttest data of students in the three classes are homogeneous with Sig. 0.05. This result is based on the criteria for taking the conclusion of the homogeneity test if the value of Sig. ≥ 0.05, then H_0 is rejected, accept Ha that the data is homogeneous.

The normality and homogeneity test results showed that the results of the pretest and post-test student learning outcomes were normal and homogeneous. Based on the N-gain value, it is known that there is an increase in student learning outcomes in the three classes. To determine the impact of using *CinQASE* e-modules was carried out on the significance of improving learning outcomes in subjects for all class groups. Paired t-tests and ANOVA were used to test for the consistency of research results. The results of paired t-test and ANOVA test are presented in Table 4.

Table 4. Paired t-test and ANOVA Test Results for Student Learning Outcomes

Paired t-test, α = 5%						ANOVA test, α = 5%					
Class	*N*	Mean	*t*	*df*	*p*	Group	Sum of Squares	*df*	Mean Squares	F	Sig.
A	25	-45.200	-37.451	24	0.000	Between groups	540.461	2	270.230	1.869	0.161
B	30	-44.667	-17.013	29	0.000	Within groups	11854.833	82	144.571		
C	30	-43.500	-18.223	29	0.000	Total	12395.294	84			

Based upon the outcomes of the t-test analysis on SPSS 25 presented in Table 4, it is known that for all class groups, the Sig. value is obtained. (2-tailed) which is 0.000 < 0.05, it can be concluded that the "hypothesis is accepted," meaning that there is a significant difference in the physics learning outcomes of 10th-grade students after intervention with the *CinQASE* e module. Table 4 also shows the results of the ANOVA test where the calculated F_{stat} (1.869) < F_{table} with a significance value (0.161) > 0.05. The results show that implementing the *CinQASE* e-module can significantly improve physics learning outcomes for all class groups.

In general, student learning outcomes taught by the *CinQASE* e-module have increased because the learning steps with the *CinQASE* phase can help students understand physics material in-depth, and forthright feedback can foster students' desire to continue learning (Hunaidah et al., 2018). Feedback makes students aware of the material that has not been mastered. Students will re-learn the material and learning that is done repeatedly can improve student understanding. In addition, with the interactive nature of the e-module, which can contain multimedia, it is possible to include text, images, and videos that make it simpler to learn for middle school students (Sung et al., 2019). The various types of media listed in the *CinQASE* e-module involve more senses that students need to know, because the learning process will be more effective if more feelings are involved in the learning process, especially in collaborative learning (Jack & Lin, 2017; Näykki et al., 2021).

The printed module has drawbacks, namely being unable to display material using simulations, so students become bored and monotonous (Puspitasari, 2019). The printed module converted into an electronic module with audio and video added to the e-module is expected to become a more interactive teaching material by adding a simulation video. In addition, e-modules are designed according to the characteristics and needs of students who find it challenging to mastery the material and practice in an online environment, which will help students maximize their learning outcomes (Nisrina et al., 2021).

Students who use interactive e-modules have better learning outcomes than conventional learning (Dewi & Lestari, 2020). This result is also followed by Latifah et al. (2020) results, which state that students find it easier and more interested in learning than opening a printed book. Using electronic modules makes middle school students simpler to study. Students can increase their learning outcomes compared to conventional wisdom with printed books or presentation media (Morris & Lambe, 2017; Sung et al., 2019).

In line with previous research, awesome media or teaching-learning materials can enhance the mastering process regarding the benefits of media or teaching materials in the globalized digital age (Hou et al., 2021; Lawrence & Tar, 2018). This refers to the media display and presentation or e-module teaching materials that can attract students' attention to create enthusiasm to understand the concept being studied. Furthermore, The findings showed that e-modules help students in the learning process understand the material faster and provide the material that the student has already discussed, thus increasing the interaction among students and teacher, since the students are already provided with the material discussed (Laili et al., 2019). Furthermore, the e-module offers easy-to-understand texts as well as images that come closer to nature. In addition, learning media are an integral part of the educational and learning process to achieve general educational goals, especially those at school.

Conclusion

Based upon the study results, it shows that the *CinQASE* e-module can improve the 10th-grade students' learning outcomes. The results of data analysis on student learning outcomes show that the value of increasing pretest to posttest through normalized n-gain

is in the medium category with a significance level through t-test less than 0.05, which means that there is a significant increase in learning outcomes after the application of the *CinQASE* e-module. Implementation of the *CinQASE* e-module can consistently improve physics learning outcomes for all class groups with Sig. (0.161) > 5%. Suggestions that we can give are that students and teachers are predicted with the intention to use the *CinQASE* e-module model with the help of a professional flip PDF in physics learning. The *CinQASE* e-module model with the reserve of a professional flip PDF is expected to solve the problem of the limitations of the physics e-module and as a teaching material when conducting learning which has been verified to be powerful in enhancing students' learning outcomes. Later, it is hoped that teachers can develop the *CinQASE* e-module model according to the material taught to students.

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