

# THE PRACTICALITY AND EFFECTIVENESS OF INTERACTIVE ELECTRONIC BOOKS OF RELATIVITY THEORY TO SELF-STUDY AND TO GENERATE STUDENTS' CRITICAL THINKING

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**ABSTRACT:** The purpose of this study is to determine the practicality and effectiveness of interactive electronic books of relativity theory to self-study and to generate students' critical thinking. This study method was conducted by quasi experimental. Data gained from 29 Senior High School Students. Data was collected by questionnaire, observation sheets and tested students' critical thinking skills. Data was analyzed qualitatively and quantitatively. Qualitative analysis used was to determine the practicality of the interactive electronic books and quantitative analysis used was to see the effectiveness of interactive electronic books. This study result is to show that the interactive electronic books can be used practically for students' self-study. Practicality as a user response shows that inter-active electronic books are very effective, highly interactive, efficient, usable, and can be used for students' self-study. The implementation of the use of interactive electronic books in overall learning worked well. This is seen from the liveliness and ease of students in using interactive electronic books. The results of effectiveness test indicate that the application of interactive electronic book in learning can improve students' critical thinking ability. The N-gain results indicate that the magnitude of differences after and before the learning is in moderate category and result of effect test is in moderate category. The average indicator of critical thinking is getting increased after being conducted the learning by using interactive electronic books.

*Keywords: Critical thinking, interactive electronic book, self-study,*

## 1. INTRODUCTION

The learning of Physics is a process studying natural phenomena to gain knowledge or seek explanations of abstract natural phenomena is a process studying natural phenomena to gain knowledge or seek explanations of abstract natural phenomena (Dede et al., 1999). The learning of Physics also emphasizes process skills to find facts, establish concepts, theories, and scientific attitudes. Difficulties experienced by students in studying physics, especially modern physics, because the concepts that students have generally obtained through daily empirical experience, while the concepts of modern physics (especially the theory of relativity) seem as though contrary to their daily experience. Another factor that also causes students to experience difficulties is the nature of modern physics concepts dominated by abstract concepts. To understand these abstract concepts in general requires a high reasoning ability (Gunawan, 2012).

The analysis result of requirement shows that physics learning process in fact that happened so far is still centered on the teacher. Most of the methods teachers used in learning are lectures (67%). The medium used by the students is the conventional student worksheet (83%) and the text book (76%). Many students revealed that the material theory of relativity is difficult to

understand (61%). This means that the book used is still static and less able to stimulate students to think critically. As a result there are still many students who have difficulty in learning physics, especially the theory of relativity. This is consistent with some studies which reveal that the learning process in fact is still teacher-oriented. Conventional learning is considered ineffective because it is less able to support the interaction between instructors and learners (Teoh & Tse, 2007; Leow & Neo, 2014). Students should therefore not only interact with teachers and text books as their learning resources, but other learning resources such as interactive e-books can be used for self-study and stimulate students to think critically. The ability to think critically is a series of activities in improving the quality of thinking by analyzing or evaluating clear, plausible, focused, and focused information on determining what to believe or do (Ennis, 2011). The use of interactive electronic books can be used as a solution to overcome the limitations of instructional media. Interactive electronic books are all kinds of digital information ranging from CD-ROM to online interactive database or collection of web pages (Shiratuddin et al., 2006; Anuradha & Usha, 2006). Electronic books containing several digital formats including PDF, RTF, word processor, HTML/ CHM or XML. This format presents information or materials in a concise and dynamic way through electronic devices such as PC and mobile (Ebied & Rahman, 2015).

The present of interactive electronic book containing indicators, learning objectives, learning materials, images, videos, animations, summaries and interactive quizzes completed with feedback, can be used independently and can stimulate students' critical thinking skills (Ambarwati & Suyatna, 2018). The interactive electronic book with interactive questions at the level of High Order Thinking (HOT) can stimulate students to think critically (Pradina & Suyatna, 2018).

Considering the usefulness and usefulness of interactive electronic books and the problems that have been presented, the purpose of this research is to know the practicality and effectiveness of interactive electronic book of relativity theory material for self-study and foster critical thinking ability.

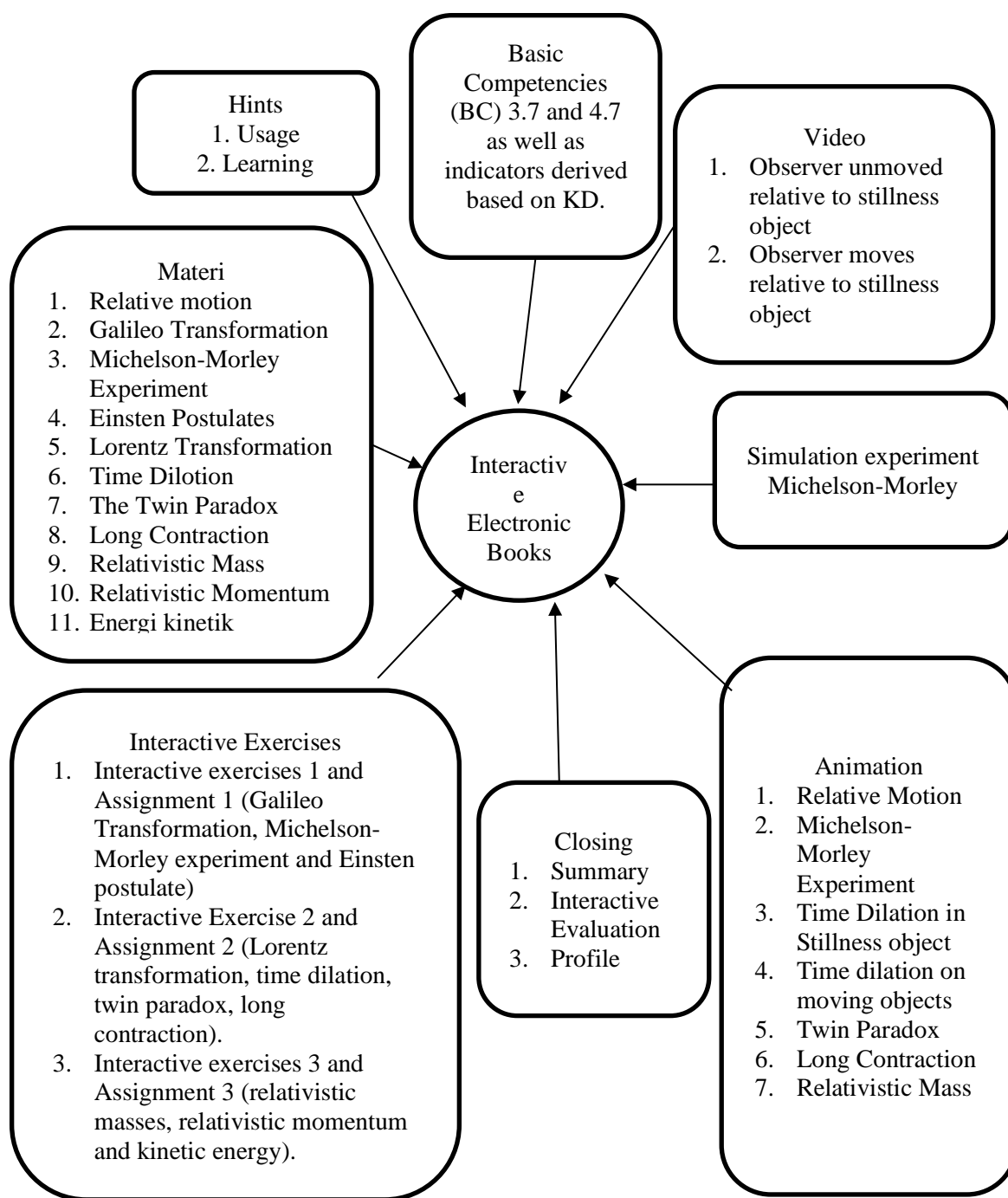
## **2. RESEARCH METHODS**

### **Research Design**

This study used quasi experiment. Data of practicality assessment result shown by student's implementation and response to interactive electronic book in the form of qualitative data, while data of effectiveness assessment result is a test of students' critical thinking skill in the form of quantitative data seen from the scores of students' pretest and posttest.

### **Sample Research and Interactive Electronic Book Series**

The subjects of this research were 29 students of class XII as a class gaining the learning by using an interactive electronic book about theory of relativity. Prior to student learning is given a test to see students' early thinking skills. During the learning process by using interactive electronic books, students' activities were observed by 2 teachers to see the interactive electronic book implementation. After the learning, the students were given response and posttest questionnaire to see improvement of students' critical thinking ability. The interactive electronic book series of relativity theory materials can be seen in Fig 1.



Source: Suyatna et al., 2018

Fig1. Interactive Electronic Book Series Material of relativity theory

### Research Instruments

The instruments of practicality consist of observation sheets and student response / response sheets. The observation sheet is used to view the interactive electronic book implementation in the lesson. The student response / response sheet to the electronic book was obtained through a questionnaire consisting of 34 items. This item includes 4 aspects of effective aspects, interact active aspects, efficient aspects, aspects of ease, and aspects of independent learning. The effectiveness of a critical thinking skill test consists of 10 essay questions.

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### Analysis Data

Data analysis of interactive electronic book practicality was done qualitatively. The practicality of interactive electronic books is viewed from the interactive electronic book implementation in classroom learning and students' responses to interactive electronic books. The practicality of an interactive electronic book was determined by calculating the average score of each aspect, then changing the average score to the value by the criteria (Suyanto, 2009). The reference to change the score can be seen in Table 1 below.

Table 1 Criteria for the Practicality of Learning Devices

Score Range	Implementation	Student Response
3.26 – 4.00	Excellent	Very Practical
2.51 – 3.25	Good	Practical
1.76 – 2.50	Less	Less Practical
1.01 – 1.75	Very Less	Very Less Practical

Data analysis is to know the effectiveness of interactive electronic book was reviewed by using inferential statistical analysis of t test, n-gain and effect size. Data analysis is to know the improvement of students' critical thinking ability by using inferential statistical analysis of t test and the mean score analysis of N-Gain and the effect size. N-gain interpretation criteria (Meltzer, 2012) as in Table 2.

Table 2. N-gain Interpretation Criteria

The average of normalized gain	Classification
$(g) \geq 0.70$	Height
$0,30 \leq (g) < 0.70$	Medium
$(g) < 0.30$	Low

The effect size test analysis is used to find out how much difference between the control class and the experimental class. Test effect size using Cohen's at <http://www.uccs.edu/~lbecker/>,. Criteria interpretation effect size by using the classification according to cohen (Sullivan & Feinn: 2012) namely:

Table 3. Classification of *Effect Size*

Large (d)	Interpretation Criteria
$0.8 \leq d \leq 2.0$	Large
$0.5 \leq d < 0.8$	Medium
$0.2 \leq d < 0.5$	Small

#### 4. DISCUSSIONS AND ANALYSIS OF RESULTS

The research was conducted in one of the existing high schools in Lampung. The learning process was begun by explaining to 29 students about the learning process that would be done that's physics learning using interactive electronic book on the material about theory of relativity, then students were asked to work on the matter of pretest critical thinking. This pretest question intended to determine the initial ability of critical thinking before the use of interactive electronic books. During the learning activities by using an interactive electronic book observed by the physics teacher at the school. At the end of students' learning was also given posttest and questionnaire of student response in using interactive electronic book. Posttest was used to know the achievement of students' critical thinking skills after learning was done using an interactive electronic book.

The result of practical analysis of the use of interactive electronic book in the form of student response after using interactive electronic book can be seen in Table 4.

Table 4. Recapitulation of Practicality Question "Student Response"

Aspect	Average	Explanation
Effective Aspect	3.44	Very Practical
Interactive Aspect	3.32	Very Practical
Efficient Aspect	3.22	Practical
aspect of Ease	3.27	Practical
Independent Aspect	3.32	Very Practical
Average	3.33	Very Practical

The result of Table 4 indicates that students' responses to the use of interactive electronic books of relativity theory is highly effective, highly interactive, efficient, easy, and can be used by students to learn independently. Based on these aspects, the use of interactive electronic books as a whole is practically used by students. Interactivity effects can facilitate experimental and evaluation activities after use. Interactivity also facilitates pace control (learning at your own pace). Interactive e-book also provides features that can support video content, animation, legibility, better educational environment and interesting to read (Sigh, 2013). Self-study enables students to explore their knowledge, while at the same time developing relationships among students that enable us to learn from one another and become more capable (Hostetler et al., 2013).

The result of the analysis of the practicality of the use of interactive electronic books from the process of its implementation can be seen in Table 5.

Table 5. Recapitulation of Observation Sheet of Observations in Learning

Observed Aspect	Average Score	Explantino
Implementation of self-study	3.37	Excellent
Implementation of the social system	3.03	Good
The implementation of reaction principle	3.39	Excellent
Average	3.28	Excellent

The results of Table 5 show that the implementation of interactive electronic books in overall learning works very well. The implementation of student learning by using interactive e-book in learning runs very well. The implementation of social systems that occur during learning also

works well. Implementation of the principle of reaction in which students behave well during learning.

The students' self-learning requirements in learning with interactive electronic books are evident from the ease of students in operating interactive e-books. Teachers provide students with opportunities to observe videos, animations and simulations to train their thinking skills. Students look able to analyze related problems presented. Students can work on interactive questions independently and able to evaluate learning independently. Most respondents prefer to learn through e-learning, because e-learning can give them greater flexibility for students' self-study and enable them to study in any place and anytime (Sun et al., 2008; Samsuri et al., 2014). Student development in learning done in madiri is better than traditional learning (non-individualized learning) (Anderson et al., 2005).

The implementation of social system can be seen from the activity of students in interaction between teacher with student, student with student, and student with learning source. Through learning activities with interactive electronic books, students tend to be more active and enthusiastic in interacting with teachers, other students, and learning resources. This is done by the students to help them in solving the problems in the interactive electronic book. The implementation of the principle of reaction seen from the role of the teacher as a facilitator can create a pleasant atmosphere.

Based on the observer observation, students look enthusiastic and comfortable in following the study of physics about theory relativitas. Students play an active role during learning and teachers are not so involved in the learning process so that students can be trained independence and ability to think. The use of electronic books acts as a good facilitator and provides comfort to students. Teaching methods used such as presenting information, testing and evaluation and providing feedback. It contributes to individualization in learners such as motivating learners and making them play an active role in the learning process. It can help develop creativity and problem-solving skills, as well as the confidence of learners (Serin, 2011). The existence of a positive interaction between students, teachers, and learning resources, it affects the implementation of social systems that get a very high percentage (Nurulsari et al., 2017). Practical teaching materials can attract interest, as well as to motivate learning (Uno, 2008).

The results of interactive electronic book effectiveness analysis seen from the improvement of pre-post critical thinking test can be seen in Table 6.

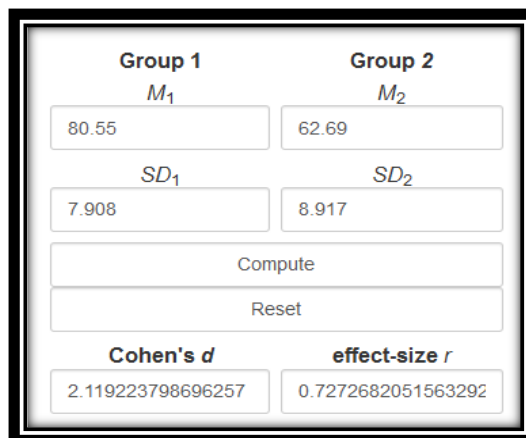


Fig 2. Effect Size Test between Experiment Class and Control Class

Based on Figure 2, the effect of interactive electronic book use on the students' critical thinking ability gets the effect-size of 0.7272 or in the moderate category. This means that learning using interactive electronic books is better than learning using traditional books. The use of interactive electronic books can also make students more focused by using interactive electronic books compared to traditional books (Mana et al., 2013; Khalid et al., 2014). Computer-based instruction books make teaching techniques much more effective than traditional techniques (Serin, 2011). E-learning can facilitate high-level learning better than traditional classrooms at aspects of innovative thinking and critical thinking (Li et al., 2014).

## **5. CONCLUSIONS**

The interactive electronic book of relativity theory is the practical development results can be used for students' self-study and is effective in fostering students' critical thinking skills. The practical result of user response shows that interactive electronic book is very effective, highly interactive, efficient, easy to use, and can be used for student self study. The implementation of the use of interactive electronic books in overall learning works well. This is evident from the ease of students in operating interactive electronic books. Students tend to be more active and enthusiastic in interacting with teachers, other students, and learning resources. The results of effectiveness test show that the application of interactive electronic book in learning can improve students' critical thinking ability ( $p < 0.05$ ). The result of N-gain shows that big difference after and before medium learning ( $g = 0.68$ ) and the result of effect size test in moderate category ( $d = 0.7273$ ) and average of critical thinking indicator experiencing aftermath after learning by using interactive electronic books.

## **6. ACKNOWLEDGEMENTS**

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