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Development of *HOTS* Oriented Physics Learning Chapter with CBR Approach on Work & Energy Material

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ABSTRACT

This research focuses on the development of HOTS-oriented physics learning e-book chapters with the CBR approach on effort and energy material for class X SMA which aims to test the validity and practicality of the e-book chapter. By using the ADDIE model (Analysis, Design, Development, Implementation, and Evaluation, this form of research is classified as Research and Development (R&D). The e-book chapter validation test process involved 3 UNP Physics lecturers as validators. In the e-book chapter practicality test to teachers, 2 teachers as practitioners from three schools. The practicality test of the e-book chapter to students was carried out on 9 students from one school. From the results of the research data analysis, the conclusions were obtained, first, the HOTS-oriented physics learning e-book chapter with the CBR approach on the material of effort and energy for class X SMA has a validity value of 0.8 with a very valid category. Second, the results of the practicality test of the HOTS-oriented physics learning chapter e-book with the CBR approach on work and energy material for grade X high school have a practicality value of 89.29 with a very practical category. Furthermore, the results of the practicality of the HOTS-oriented physics learning chapter e-book for students with the CBR approach on work & energy material for class X SMA have a practicality value of 87.79 with a very useful category. The practicality and validity results state that the e-book chapter made can be applied to the learning process.

Keywords: *e-book chapter, HOTS, CBR, work & energy*

I. INTRODUCTION

In the era of revolution 4.0, information and communication technology has increased very rapidly. Information technology is used by humans in all aspects of life because it makes work easier. Many human jobs can be done effectively and efficiently. The number of conveniences that create jobs, but over time, jobs and other professions have been replaced. Therefore, it is essential to grow quality People Resources so that they can compete and have competence. Competencies that must be possessed to face the competition are people who think critically, creatively, able to work together , independently, and communicatively. With education is expected to produce quality human resources. Education is the process of forming character and intelligence of the mind to improve abilities for the sake of a better nation's civilization through learning efforts. In its broadest meaning, education is defined as all learning events that occur throughout life in all contexts and settings and contribute to each person's development. As for the concept of education in the strict sense, it is the outcome of the institution's efforts to ensure that students entrusted to its care are competent and fully aware of their social ties and challenges [1].

To achieve the legal objectives of education, it is a challenge for the government to always make improvements to the educational system. Changes to the curriculum are one area where the government has to make improvements. Curriculum changes that have occurred in Indonesia have been carried out several times. Previously, the curriculum used was the Education Unit Level Curriculum (KTSP) which was revised to be the 2013 Curriculum.

The 2013 Curriculum which is better known as 21st century learning emphasizes several important things including Strengthening Character Improvement (PPK) which contains religious, nationalist, independent, and mutual cooperation values, Science Literacy, Critical thinking and problem solving skills, Creativity, Communication, Collaboration (4C), and Higher Order Thinking Skills (HOTS). An important aspect that students need to have is HOTS thinking skills. HOTS is a high thinking ability, students are required to process existing information and create new ideas [2]. The aspects of HOTS are not only remembering, understanding, and applying, but there are other higher abilities such as transferring one concept to another, processing information, looking for links and different information, using information to solve problems (problem solving), and critically examining ideas and information. HOTS skills prioritize the skills of analyzing, evaluating, and creating.

The 2013 Curriculum's aspirations and aims revolve around HOTS thinking skills. Creating the nation's next generation that is capable of the 21st century is undoubtedly a task for educators. Consequently, developing an efficient learning process using HOTS thinking is necessary.

In effective learning there are several factors that influence it, namely educators, students, and facilities. If there is a reciprocal link between teachers and pupils, effective learning will take place. Students must participate actively in the learning process, and instructors use a variety of teaching techniques in addition to lectures. Therefore, it is mandatory for students to be creative and innovative in utilizing ICT in the educational process so that active learning can be done, creatively, and fun. Therefore, teaching material facilities are needed that support an effective learning process that meets *HOTS thinking skills.*

Teaching materials have learning components including materials, limitations, and ways of evaluating. Teaching materials are made attractively and systematically in order to be able to achieve the required goals [3]. The nature of teaching materials is that they can provide information / learning instructions to educators and students, there are clear competencies that will be developed, including supporting information about the material presented, there are *HOTS* questions, and there is a Student Worksheet (LKPD). There are several types of teaching materials including *printed* and non-printed teaching materials such as teaching materials through sound and sound (*audio*), and teaching materials through sound/sound and images (*audio-visual*). Teaching materials that are often used by educators are books. Books can be in printed form or in electronic form which is commonly referred to as an *electronic book* (*e-book*). The utilization of e-book in this digital age definitely aids in the learning process because these educational resources are easily accessible, flexible, and cos-free to utilize.

E-books are electronic books in which there is a special chapter that discusses information in the form of text and images. E-books have experienced significant development. E-book enthusiasts are very much due to its small size, can be carried anywhere, and is not easily weathered. Another advantage of e-books is that they display animation. The vision of an e-book is as an alternative format of a book/document that can be downloaded. The benefits of e-books can reduce the shortcomings of the 2013 curriculum print book and save money on buying printed books [4].

E-book chapters will be very beneficial for learning. Generally, as a result of using media that has been around for a while to carry out yhe learning process, pupils find it boring. The e-book chapter provides the due of student's strong levels of curiosity, the most recent modifications can help make the learning process less repetitive. A chapter of the e-book described physical events that can be seen in daily life.

Physics explains the phenomena that occur in nature, so the problems that are often encountered in everyday life are inseparable from the concepts of physics. Therefore, the role of educators is needed in the physics learning process. By guiding students to master the context of knowledge, concepts, principles of physics and skills that exist in the process of science. Educators have a role as facilitators in the learning process.

The learning process in Curriculum 2013 applies a scientific approach. The scientific approach is a learning process designed for students to do activities actively by applying the 5M steps of observing, questioning, collecting data, associating, and communicating. The scientific approach is one of the alternative approaches that can be used, apart from the scientific approach, you can also use other approaches that can contain scientific steps in it.

From the demands of the 2013 Curriculum, the government always strives to improve *HOTS thinking skills.* However, the real conditions in the field of *HOTS thinking skills* in high school students are still relatively low. This is in accordance with the initial study conducted by researchers, namely by looking at the ability of students to solve the 2019 Physics National Examination questions and the availability of *HOTS thinking skills* in *the e-book chapters* used.

The first real condition is in terms of the ability of students to solve the 2019 Physics National Examination questions.

Table 1. Percentage of Students Answering Correctly at the 2019 National Examination

Theory	Percentage		
	HOTS	**MOTS**	**LOTS**
Waves and Optics	49.2%	51.8%	58.3%
Number of Questions	2 items	3 items	2 items
Electricity, Magnetism and Modern Physics	54.3%	47.2%	71.9%
Number of Questions	4 grains	6 grains	2 items
Mechanics	50.5%	49.9%	63.5%
Number of Questions	5 items	7 items	2 items
Thermodynamics	48.4%	34.2%	54.8%
Number of Questions	3 items	2 items	2 items

(Source: [5])

Based on Table 1. the four materials tested were grouped again based on the *LOTS, MOTS,* and *HOTS question categories.* After being grouped, the percentage value of students answering correctly is then averaged based on their cognitive level. It can be concluded that students answered the HOTS questions the lowest category of Wave and Optical material, the middle range of Electric Magnetism and Modern Physics, while the Mechanics material was in the low category.

The second real condition is the result of interviews with educators regarding the availability of *HOTS thinking questions* in teaching materials for physics subjects in several schools. Information obtained that students are still low in applying *HOTS thinking skills.* In addition, less interactive are the instructional tools that educators utilize during the learning process, namely books, worksheets, *handouts,* and modules. Because the current teaching materials are solely in the form of materials and are not interactive, this is one of the reasons why students get bored whilw learning. This results in students not undersanding what they are learning. In the existing teaching materials, there is also the unavailability of *HOTS -oriented questions* which makes educators unable to apply the *HOTS* -oriented learning process. Therefore, educators need *HOTS* -oriented interactive teaching materials.

Furthermore, based on the distribution of questionnaires to students conducted in several schools in the city of Padang, data were obtained in the form of learning styles and thinking skills in *HOTS*. Learning styles of students get 56% more happy to learn by using *audio*, 83% with *visuals*, and 85% with *audio visuals*. From the data obtained, it is possible to draw the conclusion that the majority of students in the area of learning styles, students are more practical in studying the learning carried out by educators in the form of audio-visual. Higher order thinking skills (*HOTS*) obtained data for students who were able to formulate problems in physics learning clearly, namely 49%, students were able to analyze problems in physics learning well, namely 51%, students were able to limit problems and think creatively to find the solution is 53%, and students who are able to test the hypothesis of a physics problem are 50%.

Based on the real conditions obtained from the data above, the ability of *HOTS* is still low. To improve the ability of *HOTS*, interactive teaching materials are needed to overcome these problems. Some of the teaching materials that are often used by educators are books, worksheets, *handouts*, and modules. However, in its use it has not motivated students which resulted in less active students during learning. With the development of an increasingly advanced era and increasingly developing technology, teaching materials in the form of books in printed form have turned into electronic books which are commonly called *e-books.*

Some educators have used *e-book chapters* in the learning process, but the *e-book chapters* are not yet interactive. The available *chapter e-books* are only in the form of pdf materials. And *the e-book chapter* used by

educators has not seen the availability of *HOTS abilities*. Where this *HOTS* ability is an ability that must exist in students in the 21st century and is a demand for the 2013 Curriculum.

From this problem, it is necessary to make a *HOTS* -oriented *e-book chapter* so that students are more happy in the learning process. The *HOTS* -oriented *e-book chapter* that will be made by the researcher will use a *Case Based Reasoning* (*CBR*) approach. *CBR* is one method to solve problems in new cases by using solutions to old cases that have the same problems and have happened before [6]. Students solve these problems based on existing examples. There are 4 stages in carrying out the *CBR approach* , firstly, *retrieve* is to look for similarities in the problem in the most similar case, secondly, *reuse* is to reuse the solution in the old case to a new case, thirdly to *revise* is to revise the solution if needed, and fourthly to *retain* is to save the new solution. for the next problem. Some of the benefits of using *CBR* are efficient because it is considered to save more time in solving problems, is more accurate and effective because it utilizes existing solutions, and can avoid repeating the same mistakes [7].

E-book chapter with a *CBR approach* yet. Moreover, in Indonesia itself, the *CBR* approach is still very new, not many people know about it and there are still few who do research on *CBR. There are* many *e-book chapters* out there , like in general *e-book chapters* that only contain text and pictures. Impressed monotone, there is no variation in it. Therefore, educators need teaching materials such as *e-book chapters* that will be developed by researchers.

HOTS -oriented *chapter e-book is* made on basic competencies 3.9 material, namely work & energy materials. Physics material that explains natural phenomena found in class X Senior High School in even semesters that require *HOTS thinking skills* . The purpose of *HOTS* will be difficult to achieve if educators deliver learning materials only by explaining verbally (in the lecture method). Often educators on the material only provide material with the lecture method, as a result, students are less interested in the material, then it is difficult to understand the material so that it can result in learning outcomes that are not as desired and lack of ability to understand concepts from students. From the Physics National Examination data in 2019 it can be seen that in the mechanics material which contains work & energy material, students answering *HOTS questions* are still in the low category, namely 50.5 % . From the observation data obtained, generally the material is delivered verbally, so that students are still difficult to understand the material. Therefore, it is necessary to have an *e-book chapter* that can improve the *HOTS* way of thinking in students.

According to the background that has been described, the researcher considers it necessary to develop a *HOTS* -oriented *e-book chapter with a CBR* approach , so that the researcher conducts a research entitled " Development of a *HOTS* -Oriented Physics Learning *Chapter E-book with a CBR* Approach on Work & Energy Materials for Class X High School.".

II. METHOD

This type of research is development research. The method used is *Research and Development* (*R&D*), using the ADDIE (*Analysis-Design-Development-Implementation-Evaluation*) model which consists of 5 stages, namely analysis, design, development, implementation, and evaluation .

The results of the development that have been made will be tested for validity by 3 UNP physics lecturers using a validation instrument sheet. Following phase is a practicality test of the product, ehich will be conducted in classroom by instructors and students using a practicality instrument sheet.

The data obtained were analyzed using the validity index proposes by Aiken's.The data from validity test results obtained were analyzed with the Aiken's validity index (V) formulated as follows:

$$V = \frac{\sum s}{n\,(c-1)} \qquad (1)$$

$$s = r - l_0 \qquad (2)$$

Information:

V = rater deal index

l_0 = the lowest score of validity assessment (in this case = 1)

c = the highest number of validity assessment (in this case = 5)

r = number given by an appraiser

n = number of raters

After obtaining the rater agreement index, the category of index value is decided. The resultd of category decisions are based on Aiken's V index as shown in Table 2.

Table 2. Decision based on Aiken's index

Interval	Category
≤ 0,4	Invalid
0,4 < $V \leq$ 0,8	Valid
0,8 < V	Very Valid

The practicality value given by teachers and students can sube calculated using the formula:

$$Value = \frac{Total\ Value}{Maximum\ Value}\ x\ 100\% \quad (3)$$

The practicality of the e-book chapter can be seen from the final score obtained in Table 3.

Table 3. Practical category of e-book chapter

Percentage (%)	Category
0%-20%	Very impractical
21%-40%	Not practical
41%-60%	Less practical
61%-80%	Practical
80%-100%	Very practical

III. RESULTS AND DISCUSSION

Analysis Stage Results

At this stage of analysis, three analyzes were carried out, namely needs analysis, curriculum analysis, and analysis of student characteristics. Needs analysis was carried out by means of observation, interviews, and completing surveys as students and teachers. The objective of the needs analysis is to see what products can be developed in the development of teaching materials. Based on observations, interviews, and findings *HOTS analysis* in textbooks, analysis of critical thinking skills, and analysis of creative thinking skills, it is necessary to develop *e-book chapters* as teaching materials to improve *HOTS thinking skills.*

At the curriculum analysis stage, pay attention to several aspects of the use of the curriculum used in schools in the city of Padang. The goal is to develop products that are produced according to the demands of the applicable curriculum. In addition, pay attention to core competencies and basic competencies learning physics. The material chosen for the development of this *e-book chapter* is work & energy with basic competencies 3.9 and basic competencies 4.9.

Furthermore, at the stage of analyzing the characteristics of students pay attention to the interests, attitudes, motivations , learning styles of students with the aim of developing products produced according to the nature of students in order to overcome the problems that occur. Learners prefer to learn with interesting and interactive teaching materials with style *audiovisuals* . This is based on the findings of the examination of the traits of students. Therefore, it is necessary to develop *e-book chapters* as teaching materials according to the learning styles of students to overcome the problems that occur.

***Design* Stage Results**

The result of this design stage is the complete form of the *e-book chapter* that has been developed. The *e-book chapter* contains titles, instructions for use, study instructions, information on *e-book chapters* , core competencies & basic competencies, indicators of competency achievement, learning objectives, materials, sample questions, student worksheets, evaluations, glossaries, bibliography, and biodata. composer.

***Develop* Stage Results**

The result at this stage is to produce a product of teaching materials in the form of an *e-book chapter* with valid work & energy materials. The *development stage* consists of a validity test. The validity test is

carried out by 3 physics lecturers and will later provide suggestions and input for the product. The conclusion from the validation results of the *e-book chapter* can be seen in Table 4.

Table 4. Overall Validity Value *of E-book Chapter*

Assessment Component	Rating Item Average	Criteria
Material Substance	0.78	Valid
Visual Communication Display	0.88	Very Valid
Learning Design	0.88	Very Valid
Software Utilization	0.83	Very Valid
Critical Thinking Ability Assessment	0.76	Valid
Creative Thinking Ability Assessment	0.79	Valid
CBR Rating	0.7	Valid
Average	0.8	Very Valid

The overall results of the validation of *the e-book chapter are* in Table 4. then the product validation that has been done is concluded that the product that has been made belongs to the very valid category.

***Implement* Stage Results**

At the *implementation stage, a* practical assessment *of the e-book chapter* that will be used is carried out. To find out the level of practicality of *the e-book chapter* The result is a practical test. This practicality test is in the form of filling out a questionnaire that is assessed by teachers and students. In the high, medium, and low school categories, a practicality test was conducted. This category is based on the results of the Physics National Examination in 2019. Based on these categories, the high school category is Senior High School A, the medium school category is Senior High School B, and the low school is Senior High School C. Table 5 contains the results that were reached.

Table 5. Results of Practicality Analysis by Teachers

Evaluator	Average (%)	Category
Senior High School A	83.71	Very Practical
Senior High School B	94	Very Practical
Senior High School C	90.17	Very Practical

In accordance with the results in Table 5. so *The e-book chapter* on work & energy material is very practical, so it can be used in the learning process.

Furthermore, the practicality of the students, the goal is to find out how the students' opinions on *the e-book chapters* that have been made. The practicality of students is carried out in one school only, namely Senior High School B. The researcher conducted a practicality test to one class, but the researcher chose the students' practicality sheet using the high, medium, and low categories. This category is determined based on the physics scores obtained by the students in the last semester. In each category, 3 students were chosen, so there were 9 students who gave an assessment of the *e-book chapter* with practicality sheets. The conclusions obtained can be seen in Table 6.

Table 6. Students' Practicality Results

Evaluator	Average (%)	Category
Practitioner A	82.67	Very Practical
B practitioner	91.37	Very

Evaluator	Average (%)	Category
C practitioner	83.86	Practical Very Practical
D practitioner	91.70	Very Practical
E Practitioner	91.04	Very Practical
F practitioner	80	Practical
G practitioner	88.83	Very Practical
H practitioner	95.19	Very Practical
Practitioner I	86.93	Very Practical
Average	87.79	Very Practical

Data from student's practicality test shows test shows that the e-book chapter falls within the very practical category since it meets the criteria for being clear, attractive, and effective.

The results obtained from the research are the results obtained at each step using the ADDIE model. This research focuses on products in the form of *e-book chapters* that are valid and practical to use in the learning process on work & energy materials. There are five stages of development with the ADDIE model, namely *analysis, design, development, implementation, and evaluation*. The characteristic possessed by the development of this ADDIE model is the evaluation at each stage.

The first step is the analysis stage. Activities in this analysis stage are divided into 3, namely needs analysis, curriculum analysis, and student analysis. The results of this analysis will be the basis for the development of the *e-book chapter* that will be carried out. Stages of analysis are carried out by means of observation, interviews, and filling out questionnaires by educators and students.

The results of the analysis obtained from the first analysis stage, namely needs analysis. The teaching materials used in Senior High School throughout the city of Padang are still classified as not interactive, because from the results of interviews with teachers they still use textbooks and teaching materials in the form of pdf files. The teaching materials used are only in the form of writing accompanied by pictures so that the learning process becomes monotonous, so many students get bored quickly when learning. The next analysis is the use of teaching materials in the form of textbooks in schools in the sufficient category. In the textbook used, a re-analysis of the availability of *HOTS thinking is carried out* in this case the ability to think critically and creatively. The results of the analysis obtained on the ability to think critically and creatively in the sufficient category. This confirms that there is a need for the development of *e-book chapters* to optimize higher order thinking skills (*HOTS*). Furthermore, the analysis is carried out to select the material to be developed, the analysis is carried out from the 2019 Physics National Examination data which shows the percentage of each material. One of the materials with a low percentage is mechanics. One of the materials is work and energy. The material of work and energy is a material that is closely related to everyday life, so it is necessary to understand more about the material of work & energy.

Characteristics of students are closely related to interest in learning and learning styles of students. Rijal (2015) states that students are people who are at the stage of learning and developing, each having their own uniqueness and character in the learning process. The uniqueness of each student has a varied response to understanding learning. Both in terms of attitudes and learning styles that support learning success. The data obtained from the results of filling out the questionnaire is that students are interested in interesting teaching materials. One of the teaching materials that is often used is *the e-book chapter* . Interesting *e-book chapters* contain material, pictures, animations, videos, and evaluations that can make students think about solving them. Based on the results of the overall analysis, it can be concluded that it is necessary to develop a *HOTS* -oriented physics learning *chapter e-book with a CBR* approach in work & energy materials for senior high school class X.

The conclusion obtained from the analysis stage is that the teaching materials in the form of an *e-book chapter* are designed based on the 2008 Ministry of National Education which consist of titles, instructions for use, study instructions, core competencies & basic competencies, indicators of competence achievement, learning objectives, relevant materials, sample questions, student worksheets, evaluations , glossary, references, and author biodata.

Based on the design of teaching materials in the form of an *e-book chapter* that has been made, an *e-book chapter is produced* . The resulting *e-book chapter was validated by three validators of UNP physics lecturers.* Before validating *the e-book chapter* , firstly the validity instrument sheet and practicality instrument are validated to obtain a valid *e-book chapter validation and practicality instrument sheet* . three UNP physucs lecturers also approved the instrument sheet. Once throughout an evaluation, the instrument validation stage is completed. The instrument sheet is given to the validator, then it will get suggestions and input, after that it is corrected according to the suggestions and then the validator will give a value to the validity of the instrument.

The next stage is the validation *of the e-book chapter. The e-book chapter* was validated by three validators from UNP physics lecturers. Testing the validity of a product must be done by experts [8]. *The e-book chapter* will be validated based on a valid instrument. The validated e-book chapter is sent to the validator, explained to the validator, then the validator will provide comments, suggestions and input for the improvement of the e-book chapter. Furthermore, the chapter e-book will be revised according to the suggestions and input from the validators, then an assessment will be given to the chapter e-book. The results of the validity test are generally said to be valid for use if all aspects can be said to be valid [9]. At the validation stage, there are seven assessment components in the validation instrument, namely material substance, visual communication display, learning design, software utilization, critical thinking skills assessment, thinking skills assessment, and CBR assessment.

Furthermore, after completing the validity test which resulted in a valid e-book chapter, the next step is to test the practicality of the product to teachers and students at Senior High School in Padang city. The practicality test for teachers was conducted in three schools with high, medium, and low criteria. The high criteria school is Senior High School A, the medium category school is Senior High School B, and the low category school is Senior High School C. The practicality test asked for the willingness of two teachers from each school. The practicality test used a valid practicality instrument.

There are three aspects of assessment on the practicality instrument, namely easy to understand, interesting, and efficient [10]. There are aspects that must be considered in the practicality test, namely the time in the learning process must be effective and efficient and the resulting e-book chapter is able to attract student learning interest [11]. Apart from that, teaching materials in the form of e-book chapters should have an attractive color composition, so that users are not bored and confused in using these teaching materials. Product development research developed is practical if experts and practitioners state that the product can be used and utilized with good categories [12]. Based on the results of the practicality test by six teachers and nine students, it was found that the product in the form of an e-book chapter was very practical.

The results of the validity and practicality tests have been carried out, so the development of HOTS-oriented physics learning e-book chapters with the CBR approach on senior high school class X work & energy material is declared very valid and very practical to use in the learning process. This is the goal of the e-book chapter development carried out by researchers and the e-book chapter can be used in the learning process on the material of work & energy.

IV. CONCLUSION

After the research is done, it can be concluded that the development of the *e-book chapter* on the results of the validation test has a very valid validity value. The validity components of this *e-book chapter* are valid in terms of material substance, visual communication display, learning design, software utilization, critical thinking ability assessment, creative thinking ability assessment, and *CBR assessment* .

Furthermore, the e-book chapter for instructors and students has a very practical category based on the findings of the practicality test. The practical aspects of this *chapter's e-book* are practical in terms of being easy to understand, interesting, and efficient. So that *the e-book chapter* can be used in the learning process at school or during independent learning by students.

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