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# Development of PJBL-STEM based E-books Assisted by Geometry Calculator to Foster Students' Critical Thinking Ability

## Abstract

A characteristic of students in 21st century learning is critical thinking, having the ability & willingness to digital literacy, ICT, and new media, as well as adaptive and flexible initiative. However, currently, junior high school students' critical thinking abilities are still at a low level. Therefore, this research aims to develop e-book mathematics learning media based on PjBL-STEM assisted by Geometry Calculator to improve students' critical thinking skills. This type of research is research and development using the ADDIE development model which includes five stages, namely analysis, design, development, implementation, and evaluation. The research subject was MTs NU Mranggen class VIII. The research instruments were material validation questionnaires, media validation questionnaires, and student critical thinking tests. The research results showed that (1) The media was declared suitable for use according to material experts, the validity level of the three material experts was 82%, 86% and 93%, while the validity level of the two media experts was 86% and 92%. (2) The average score for the experimental class was 81.04 while the control class was 64.96, so the learning media was declared effective. This research is very useful for improving students' critical thinking skills through developing a PjBL-STEM based e-book with the help of a Geometry Calculator on circle material used in learning. The unique thing about this research is that it is easier for students to learn because they use e-books which can be read anywhere and anytime. Apart from that, the e-book contains the PjBL-STEM learning method with the help of a Geometry Calculator which can make it easier for students in the learning process.

**Keywords:** E-book; PjBL-STEM; Geometry Calculator; Think Critical

## Abstrak

Suatu karakteristik siswa pada pembelajaran abad 21 yaitu berpikir kritis, memiliki kemampuan & kemauan literasi digital, ICT dan media baru, serta terinisiatif yang adaptif dan fleksibel. Namun saat ini, kemampuan berpikir kritis siswa SMP masih pada tingkatan rendah. Oleh karena itu, penelitian ini bertujuan untuk mengembangkan media pembelajaran matematika e-book berbasis PjBL-STEM berbantuan Geometry Calculator untuk meningkatkan kemampuan berpikir kritis siswa. Jenis penelitian ini adalah penelitian dan pengembangan dengan menggunakan model pengembangan ADDIE yang meliputi lima tahapan yaitu analisis, desain, pengembangan, implementasi dan evaluasi. Subjek penelitian adalah MTs NU Mranggen kelas VIII. Instrumen penelitian berupa validasi angket materi, validasi angket media, dan tes berpikir kritis siswa. Hasil penelitian menunjukkan bahwa (1) Media dinyatakan layak pakai menurut ahli materi, tingkat validitas ketiga ahli materi adalah 82%, 86% dan 93%, sedangkan tingkat validitas kedua ahli media adalah 86% dan 92%. (2) Hasil nilai rata-rata kelas eksperimen 81,04 sedangkan kelas kontrol 64,96 sehingga media pembelajaran dinyatakan efektif. Penelitian ini sangat berguna untuk meningkatkan kemampuan berpikir kritis siswa melalui pengembangan e-book berbasis PjBL-STEM berbantuan Geometry Calculator terhadap materi lingkaran yang digunakan dalam pembelajaran. Hal unik dari penelitian ini yaitu siswa lebih mudah untuk belajar karena menggunakan e-book yang dapat dibaca dimanapun dan kapanpun. Selain itu, e-book tersebut di dalamnya memuat metode pembelajaran PjBL-STEM yang berbantuan Geometry Calculator yang dapat memudahkan siswa dalam proses pembelajaran.

## INTRODUCTION

The 21st century learning model emphasizes critical thinking, connecting students' knowledge with the real world, mastery of information and communication technology, and collaboration. Some of the skills needed by students in the 21st century is called the 4Cs, including critical thinking and problem solving, creativity, communication (the ability to communicate) and collaboration (the ability to

work together). To implement these skills, teachers must understand learning styles that suit the characteristics of 21st century students.

A characteristic of students in 21st century learning is critical thinking, having the ability & willingness to digital literacy, ICT, and new media, as well as adaptive and flexible initiative (Syahputra, 2018). In the 21st century, students are part of generation Z or millennials, where they have been used to technology since birth. This

can make students' characteristics more developed, who are more critical, creative, have high curiosity, are competitive and prefer things that are instant and don't like to spend too long in class.

However, students' critical thinking abilities are still at a low level. This is supported by Arma<sup>18</sup> and Budiman (2022) who argue that critical thinking skills in junior high school students are at a low level. Several factors have an impact on students' low critical thinking abilities, namely that students during learning still prioritize memory and understanding processes (Agnafia, 2019) and teachers use more lecture methods and practice solving problems quickly without understanding concepts in depth (Hidayah, Sulasmono & Widyanti, 2019). According to Nurazizah & Nurjaman (2018) and Rosyidah, Kusairi & Taufiq (2021), students' difficulties<sup>3</sup> in solving a problem with mathematical critical thinking skills are due to weak understanding of concepts. This is supported by Pramuditya & Nugroho (2019) that the causes<sup>3</sup> of students not thinking critically are a lack of activeness in asking questions, a lack of understanding of the material, and practice questions with unequal levels of difficulty. These findings indicate that this research can provide information to teachers about students' critical thinking abilities so that it is hoped that teachers can improve each student's critical thinking abilities by designing and preparing learning activities.

The learning model provided by the teacher will have a great influence on education to overcome student problems and prepare learning so that students' minds become more critical (Fauzi, Widia & Islami, 2020). Based on the explanation about critical thinking, there are many descriptions of how to solve mathematical problems (Kurniasih and Hakim, 2019).

Thus, after teaching and learning activities using STEM PjBL, students' critical thinking abilities become better (Rosyidah et al., 2021).

Learning using e-books implemented using the PJBL-STEM method will have a greater influence on student learning outcomes (Andaresta & Rachmadiarti, 2021). This e-book media is very practical and can be accessed by students anywhere and anytime easily via computers, laptops, cellphones, and tablets. One of the uses of e-books to realize 4C competencies is critical thinking, where teachers must understand appropriate learning that suits the characteristics of 21st century students.

Because students in the 21st century are generation Z or millennials where students prefer something instant, this research uses an Android application called a geometry calculator. The following is a picture of the geometry calculator application:

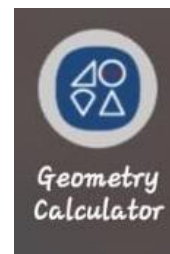


Figure 1. Geometry calculator application

The advantage of the geometry calculator is that it helps students calculate faster and make it easier to get the correct answer. Students are expected to have a positive response to the use of learning media using the geometry calculator to improve critical thinking (Samosir, 2020).

Researchers believe that circle material is one of the problem materials in mathematics learning, especially in class VIII. One of the materials in mathematics is circles. This is supported by Gerhani, Bey & Ndia (2019) that measuring circumferential angles, central angles, arc

lengths, area of sections and area of edges in a circle describes one of the mathematics lesson materials for class VIII middle school/mts students, one of the materials that is quite difficult to understand by students. This is because the circle is a provision for the concept of mathematical material that follows, namely the concept of trigonometry which is studied in high school (Nurazizah & Nurjaman, 2018). Therefore, circle material is very suitable for improving students' critical thinking skills.

Based on the conclusions above, it is necessary to carry out research that can improve the critical thinking of 21st century students by using PJBL-STEM based E-book development assisted by the Geometry Calculator application.

## METHOD

Research and development (R&D) is employed in this study. Development research is a type of research that develops certain goods and evaluates their efficacy (Sugiyono, 2017). An e-book built on PjBL and STEM will be the study's final output, and it will help students develop their critical thinking abilities. The ADDIE development model, which has five phases, is used in this study. The first step is **Analysis**, which involves examining the learning requirements to determine the proper problem to solve and the appropriate level of student competency; **Design** involves choosing distinctive skills, methods, and resources for instruction or teaching materials; **Development**, the process of producing educational initiatives' curricula and teaching materials; **Implementation**, the process of carrying out a learning program in accordance with a plan or specification for the program; **Evaluation**, assessing learning programs and evaluating learning outcomes.

This research process was carried

out at MTs NU Mranggen, Mranggen District, Demak Regency. Implemented in the even semester of the 2022/2023 academic year. In this study there were 46 students consisting of 22 students from the experimental class and 24 students from the control class.

Activities carried out in stages evaluation among them analysis results validation, analysis results questionnaire and analysis pretest and posttest results. The data collection techniques used in this study are shown in Appendix Table 1.

In this study the researchers used indicators of critical thinking skills according to FRISCO because according to researchers they were more complex, indicators according to FRISCO included: (1) *Focus*, meaning directing attention towards selecting solutions based on current issues; (2) *Reason* (reason), provide a good explanation (reasonable) for the choices made; (3) *Inference* (conclusion), Conclusion considers the situation and existing evidence, identifies various arguments and assumptions, seeks alternative explanations, and draws conclusions based on compelling evidence; (4) *Situation* (situation), understand the solution of the problem that led to the situation or situations; (5) *Clarity* (clarity), clarify the terminology used and its meaning; (6) *Overview* (re-examining), carefully re-examining the situation to determine whether the decisions made were accurate.

The results of the percentage of data obtained are then interpreted according to table 2.

Table 2. Criteria Evaluation To validan E-books

| Percentage | Criteria   |
|------------|------------|
| 81 %—100%  | Very Good  |
| 61 %—80%   | Good       |
| 41 %—60%   | Enough     |
| 21 %—40%   | Not enough |
| 0 %—20%    | Less Once  |

E- book effectiveness data in critical thinking skills acquired through results *pretest* and *posttest*. Ability measurement critical thinking in students is done in a way compare *pretest* results and *posttest* which analyzed through N-Gain test which adapted from (Hake, 1999).

$$N\text{-gain} = \frac{\text{skor pretest} - \text{skor posttest}}{100 - \text{skor pretest}}$$

Then, compare with table 3 for know classification as following:

Table 3. N-gain clarification

| Range Mark         | Criteria  |
|--------------------|-----------|
| $g \geq 0.7$       | Tall      |
| $0,3 \leq g < 0.7$ | Currently |
| $g \leq 0.3$       | Low       |

## RESULTS AND DISCUSSION

### Results

Following is the ADDIE (Analysis, Design, Development, Implementation, and Evaluation) development model with the explanation as following.

#### Analysis

1) Material analysis was carried out to obtain information regarding learning materials by conducting interviews with class VIII students at MTs NU Mranggen. It was found that students at MTs NU Mranggen still had difficulty in circle material. For this reason, teachers need to use learning media that can make it easier for students to understand circle material, one of which is using the Geometry Calculator application.

2) A needs analysis was carried out to obtain information regarding the availability of teaching materials by conducting interviews with class VIII Mathematics teachers at MTs NU Mranggen. It was found that students' critical thinking skills at MTs NU Mranggen were still less than

optimal. This is due to students' lack of critical thinking skills, therefore researchers offer e-books which include the PjBL-STEM learning method.

#### Design

After the analysis stage, it can be concluded that students experience difficulties in learning, resulting in a lack of critical thinking. Therefore, researchers compiled materials and designed teaching and learning activities that were suitable for the above problems. At this stage the researcher got the right results to overcome the problem of students' lack of critical thinking, namely by using e-books and Geometry Calculators to make it easier for students to learn circle material.

#### Development

On this stage, writer make product form e-books on circular material that has various stages starting from analysis to design and development product in form e-books. During the development stage, the researcher collects the material can support development e-books based PjBL-STEM thank you geometry calculator. After that the researchers produced it and validated it para expert that is expert media, expert material, as well as respond teacher. So, link e-book distributed to students to see responses about practicality media the learning. From the results response student done for know response student to e-book based product whole aspect obtained percentage of 28% in the category "Strongly Agree", 64% in the category "Agree", 5% in the category "Enough Agree", 2% category "No Agree" and 1% category "Strongly Disagree Agree". So, conclusion from response data student the is an e-book already worthy used. Following is Figure 2 results response student to e-books.

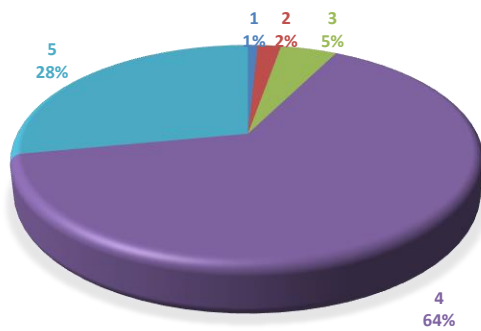


Figure 2. Response results student to e-books

Kindly general procedure this research includes: (1) **Stage Preparation** includes: a) Coordination and Licensing; The researcher coordinated with the school where the research took place. The purpose of this activity is to find out whether researchers are allowed to do research in schools. b) Determination of the research sample, the researcher took the sample using the cluster random sampling technique. The sample of this research is class VIII MTs NU Mranggen, Demak Regency. Then two classes were randomly selected, which became experimental and control classes. c) Define Categories Test, To determine the experimental class, a class is taken that is not a research sample. d) Analysis of previous data, before conducting the research, the researcher first asked for baseline data in the form of previous test scores from the two sample classes, after which the baseline data was carried out through a survey to find out whether the the control class and experimental class had the similar baseline ability. e) Preparation of Learning Devices, In this activity the researcher prepares learning devices that will be used for the experimental and control classes, such as syllabus, lesson plans, assessment rubrics and others. f) Conduct experiments and analyze test results to determine validity, reliability, discriminatory power, and difficulty. Then select questions that meet the criteria to be used as a posttest. These

questions were then presented to experimental and control classes as evaluation to obtain final data.

(2) **Implementation Stage** includes a) Implementation of treatment according to the study plan, namely the experimental class with a project-based learning model with a STEM approach and a control class with a conventional learning model. b) held *posttest* in the experimental class and control class.

(3) **Final Stage** includes a) After the desired data is collected, further processing and analysis is carried out to decide on the result. b) Make a research report. c) Do leadership with boss.

### Implementation

During this experimental phase, researchers conducted small-group and limited trials. Small test to determine the readability of e-book media before testing with a limited group. In small group trials, students observed digital book media by filling out a questionnaire to determine the readability level of e-book media. After the e-book is validated and revised 3 times, it will be taught to the students in the research class. Then carry out the learning program using the design created, namely an e-book based on PjBL-STEM assisted by a geometry calculator to improve students' critical thinking skills. Analyze test items before reviewing questions for experimental and control classes. First, we tested a pilot class, class VIII B questions, to determine the relevance, reliability, uniqueness, and difficulty of the test items. A trial class is a class in which you receive circle teaching materials. Valid questions are determined based on results analysis question test as many as 14 questions of 15 questions description. Through calculation reliability question, obtained results that

questions test the is reliable with Classification "Good Once". Every question own level different difficulty, of 15 questions there are 3 questions easy, 6 questions medium and 6 questions hard. Furthermore, power differentiator of 15 questions are 2 questions categorized as not enough OK, 13 questions categorized as very good. Kindly whole from results analysis, of 15 questions instrument tested, obtained 12 questions that are feasible for tested, will but from researcher only take 10 questions because related with time processing question i.e. 80 minutes.

Following is appendix table 5 about indicator think critical and questions. The test instrument used in this research is valid and reliable (Pramasdyahsari et al., 2022).

### Evaluation

Product revisions are carried out to improve the quality of teaching materials produced by improving the design and content of learning environment materials, which are carried out based on input and suggestions from experts before being tested on students. With the production version, it is hoped that the media can be used and tested try it on students. This evaluation aims to measure the achievement of development goals. At stage this is also done evaluation impact the development of e-book media for increase ability think critical student. Assessment is done in the workplace according to the test questions in the lesson experiment and lesson administration. Previously tested subjects will be questioned about test validity, reliability, difficulty, and performance differentiation before post-test questions are asked for control of the experiment and class. After the questions were tested, the researcher chose only one of her 10-point questions.

Development is based on research based on the results of e-book development. It consists of three main parts, namely the cover and instructions for use, teaching materials and lesson plans. The preparation of the e-book is a reference from Pramasdyahsari et al. (2022). The core section includes student learning assignments that involve PjBL STEM syntax. Following are some of the features of the e-book shown in figs 2 - 4.



Figure 2. Feature e-book cover

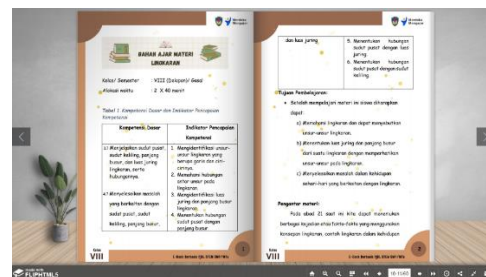


Figure 3. Features of teaching materials circle

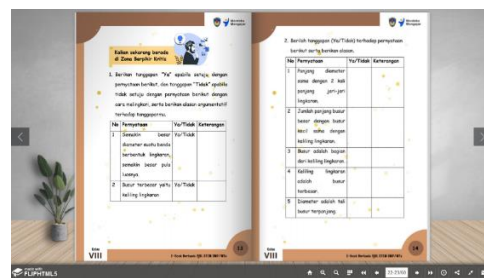


Figure 4. Question features think critical

The following must be revised in the e-book seen in table 6.

Table 6. Revision on the e-book

| No | Revision   |
|----|--|
| 1  | Number page better is at number 8.                           |
| 2  | Circle image used should more precision to match definition. |
| 3  | Take note font selection, make sure easy read.               |
| 4  | Attachment page eliminated.                                  |

E-book which was developed in the research consists based PjBL-STEM. Syntax learning on PjBL-STEM according to the model Laboy-Rush that is Reflection, Research, Discovery, Application and Communication.

### Validation Expert Material

Validation by material expert covers five aspect appraisals. Following this results analysis percentage validation expert material on table 7.

Table 7. Results of Material Expert Module Validation Analysis

| No          | Aspect Evaluation | Score Observation | Score Maximum | Appropriateness |
|-------------|-------------------|-------------------|---------------|-----------------|
| 1           | Learning          | 19                | 20            | 95 %            |
| 2           | Skills            | 21                | 25            | 84 %            |
| 3           | Think Critical    | 25                | 30            | 83 %            |
| 4           | STEM PJBL         | 8                 | 10            | 80 %            |
| 5           | Benefits          | 17                | 20            | 85 %            |
| Total Score |                   | 90                | 105           | 86 %            |

Table 7 shows a total average of 86 %. The percentage shows the category very lawful. Based on results of the validator shows that the e-book with the five aspects of research it's worth it.

### Validation by Expert Media

Validation by media expert covers three aspect appraisals. Following this results analysis percentage validation expert media on table 8.

Table 8. Media Expert Validation Analysis Results

| No          | Aspect Evaluation                | Score Observation | Score Maximum | Appropriateness |
|-------------|----------------------------------|-------------------|---------------|-----------------|
| 1           | Skills                           | 23                | 25            | 92 %            |
| 2           | Display and communication Visual | 23                | 25            | 92 %            |
| 3           | Benefits                         | 18                | 20            | 90 %            |
| Total Score |                                  | 64                | 70            | 92 %            |

Table 8 shows the results with a percentage of 9.2% which has a very valid category. As for the test decision by the validator on e-books it's worth it used.

### Effectiveness Test Results

E-book validity test results are based on pre- and post-test results for students and consist of four items that include aspects of a student's critical thinking. The value of the pretest and posttest will be processed by the N-testgain to determine effectiveness. e-books. Following is results test N-gain found on table 9.

Table 9 . N-Gain Test Results Descriptives

|              | Class       | Statistics | std. Error |
|--------------|-------------|------------|------------|
| Ngain_persen | Exper-iment | 62.8016    | 4.96399    |
|              | Con-trol    | 28.7227    | 4.03804    |

Based on table 9 show that mark N-gain for class experiment is as big 62.8016 or 62.80% including category "Enough Effective". Temporary for control class is as big 28.7227 or 28.72% included category "No Effective". So can concluded that use e-books based PjBL-STEM assisted geometry calculator enough effective for increase ability think critical student to student class VIII A. Meanwhile use method conventional no effective for increase ability think critical student to student class VIII B.

### Discussion

Based on the results of the e-book validity test, the e-book has a high category value. This is seen based on the value of students' critical thinking which has increased. High scores on the N-Gain test indicate that studying with e-books may



improve critical thinking skills, especially when learning is taking place. The development of an e-book can improve students' critical thinking skills because the e-book has several advantages as follows; a ) Make the learning process more interactive, b ) Save expenses in the learning process, c ) Its physical size is easier to carry, easy to process and attracts students to study hard.

According to Fitriani and Rohayati (2013) argued that the developed e-book based learning has criteria that are feasible to use and are very good in the learning process. The e-book is very practical for students in terms of material, language and graphics (Widiyanti & Kurniawan, 2021). In addition to the benefits mentioned above, e-books can also upgrade students' intrigued in learning results (Rosmery T et al., 2020).

Learning using the E-book which is implemented using the PJBL-STEM method will have a greater effect on student learning outcomes (Andaresta & Rachmadiarti, 2021). In this e-book that has been developed, students are trained to think and predict the appropriate answer, as well as to associate the material with phenomena that are around us, one of which is through wingko rainbow tripe. Activities from students to predict answers and clarify answers that have been proposed, can empower thinking skills. One of the syntaxes in STEM-PjBL is to formulate a problem in the form of a question (Andriani et al., 2023).

Increasing critical thinking skills cannot be separated from appropriate methods to support the learning process. In this study PjBL-STEM was used as a learning model in e-books . The PjBL-STEM model has a learning syntax. The PjBL model guides students to be able to solve problems and emphasizes contextual learning in complex ways (Farah et al., 2017). In the syntax contained in PjBL-

STEM students are given phenomena related to a problem that exists in the surrounding environment. Research Rosyidah et al. (2021) states that after teaching and learning activities using STEM PjBL students' critical thinking skills became better . In addition, e-book development This has been done by researchers before them (Buchori et al., 2022; Setiyoaji et al., 2020; Bayani, 2019; Andaresta et al., 2021).

Regarding the revision of the final product, a hypothetical product was applied to understand how students react to the learning process using PjBL-STEM based e-books. To help students and teachers complete projects more easily, this e-book includes a teacher lesson plan. This is in line with previous research which shows that e-books included in lesson plans can make it easier for students and teachers to complete projects (Pramasdyahsari et al., 2023) as shown in Figure 5 below.



Figure 5. E-book: RPP

However, the learning process is not limited to this plan. Depending on the circumstances of the class, teachers and students can elaborate and build more.

The results of using PjBL-STEM based e-books can improve students' critical mathematical thinking, this is in line with previous research which shows that

STEM students' reasoning abilities can be improved by gaining knowledge using digital simulations (Verawati et al., 2022).

The following is an illustration of a PjBL-STEM based project in Figure 6.



Figure 6. E-book: PjBL-STEM project activities.

E-books can encourage children to actively participate in activities and experiences, as seen in Figure 6. PjBL-STEM project activities are divided into four parts in the e-book. The first activity asks students to understand the problem and plan several potential solutions. The second activity asks students to design the best solution to the problem of how to divide the number of wingko tripe equally. The third activity allows students to discuss in groups how to color the project appropriately. Finally, the fourth activity allows students to discuss in groups about the correct width of the arc and the length of the arc.

In general, the use of PjBL-STEM based e-books can improve students' critical mathematical thinking. Because students' initial abilities are below average,

this will be a long-term learning experience for them. Through STEM project-based learning, students gain experience in collaboration and communication. In addition, students are used to solving problems in stages and could express their arguments in group discussions. According to Jolly (2016), the presence of EDP in this project helps students acquire 21st century learning skills such as problem solving, critical thinking, creative thinking, collaboration, and communication.

Based on the results of the t-test and N-gain calculations, it can be concluded that the critical thinking talent of experimental class students (VIII A) experienced an increase before and after using the circle e-book media in the teaching and learning process. The results of this conclusion are in accordance with previous research Zuhaida et al. (2022), Aprilia (2021) and Rasiman and Pramasyahsari (2018) which stated that the scores of students who studied using e-books were higher than the scores of students who studied with textbooks. Sukmana et al. (2022) in his research stated that the results of the students' pretest scores before using the e-book in the teaching and learning process were 51 while after using the science e-book the posttest was 86.5.

## Implication of Research

The results of this research show a significant increase in students' critical thinking abilities. In addition, the STEM-PjBL e-book application also stimulates the skills needed for 21st century learning, such as creative thinking, collaboration, and communication. In addition, students were impressed with the STEM-PjBL digital book and interested in gaining knowledge through an active teaching and learning approach that combines ICT tools and STEM-PjBL aspects. Therefore, it is hoped that this research can provide information

to educators to develop learning media on other materials, provide alternative choices of learning methods in Junior High Schools (SMP) or other school levels to improve students' critical thinking skills in learning mathematics by paying attention to mathematical concepts.

### **Limitation**

This research has limitations including the number of students who tested the product, which resulted in varying responses, and the number of product advocates to verify its accuracy and validity from the methods used. In addition, this research was not conducted longitudinally to determine whether the effectiveness or influence of media on students' critical thinking abilities changed or was maintained over time. However, the results of this research can be used as evidence that the development of e-book-based PjBL-STEM learning with the help of Geometry Calculator can improve critical thinking skills, there is no change in student assessments.

### **CONCLUSION**

The product developed is an e-book based *PjBL-STEM* help geometry calculator for

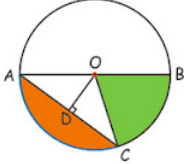
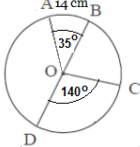
junior high school students who have met the valid criteria based on expert judgment. The average validation score obtained was 87.8 in the "very good" category. From discussion above then several conclusions can be drawn matter that: 1) Learning media within the frame of e-books based PjBL-STEM help geometry calculator for increase ability think critical valid student or worthy used in learning. This obtained from results validation test assessment media experts and experts demonstrating material very good category. 2) Learning media within the frame of e-books based PjBL-STEM help geometry calculator for increase ability think critical student stated practical used in learning. This obtained from results questionnaire evaluation the practicality of learning media that shows very practical category. 3) Learning media within the frame of e-books based PjBL-STEM help geometry calculator for increase ability think critical student stated effective to enhancement ability think critical student. This be marked with enhancement ability think critical in class experiment taller compared to with class control.

Appendix of Article Entitled Development of PJBL-STEM based E-books Assisted by Geometry Calculator to Foster Students' Critical Thinking Ability

Table 1. Data collection engineering

| Data collection engineering   | Instrument           | Data source         |
|---|----------------------|---------------------|
| 1. Interview<br>Through interviews, the activities and learning outcomes of circular mathematics were examined. The results of the interviews became the basis for whether or not the research was conducted.   | interview guidelines | Mathematics Teacher |
| 2. Documentation study<br>Documentation study with see mark mathematics in class VIII A & B on matter circle . This document study is the basis for determining whether or not a study is necessary.  | Document mark        | Mathematics Teacher |
| 3. Validation of e-book media<br>Validation is carried out by people who meet the requirements by marking the appropriate statements and filling in suggestions and input. Validation is used to determine media effectiveness.   | Validation sheet     | 2 material experts  |
| 4. Research instrument validation<br>Research instruments include syllabus, e-books, pre-test and posttest questions, lesson plans.   | Research instrument  | 3 material experts  |
| 5. Questionnaire<br>Student given A questionnaire after learning to use the e-book. Questionnaire results for judging the practicality of media.  | Questionnaire sheet  | Student             |
| 6. Questions pretest and posttest<br>Pre-test and post-test questions were used to identify students' critical thinking skills increased before and after using the e-book . The results of the post-test were compared with the KKM to determine the effectiveness of the media. | Question sheet       | Student             |

Table 5 . Indicator Think Critical and Problem

| Critical Thinking Indicator  | QUESTION   |
|--|--|
| <p>1) F ( <i>Focus</i> ), students understand the problems in the questions given.</p> <p>2) R ( <i>Reason</i> ), Students justify each step of their decision-making and conclusions based on relevant facts/evidence.</p> <p>3) I ( <i>Inference</i> ), a) Students correctly draw conclusions. b) Students select the correct reason to support the conclusion drawn.</p> <p>4) S ( <i>Situation</i> ), Students use whatever information is appropriate for the problem.</p> <p>5) C ( <i>Clarity</i> ), a) Students further explain what the conclusion means. b) If the assignment contains terms, students can explain them. c) Students do a case study similar to the problem.</p> <p>6) O ( <i>Overview</i> ), Students research or review thoroughly from start to finish (prepared by FRISCO).</p> | <p>1 Henry has a circular pizza . The pizza is 28 meters in diameter. The green part is a pizza with a melon flavor angular, the orange part has a 45°citrus taste and pizza color white has an original taste. Here Hendri want to know elements circle of the pizzas. Here below is a pizza sketch.</p>  <p style="text-align: center;"><b>Orange</b>                      <b>Green</b></p> <p>1 a. What information do you know from the questions above?</p> <p>b. Why is BOC said as sector ? Give your reasons!</p> <p>c. From the information you have get before , conclusion what are you can about sector ?</p> <p>d. Elements What just formed _ in the pizza sketch ? Explain your opinion!</p> <p>e. Do you agree if wide BOC index is <math>77 m^2</math>? Explain your reasons!</p> <p>2 Mrs. Dwi bought a plot land shaped circle. Circle the have 2 pieces the jury that consists from AOB section and COD section. If is known corner <math>\angle AOB</math> is <math>35^\circ</math> and the angle <math>\angle COD</math> is <math>140^\circ</math>. Answer the questions below This if length <math>AB = 14</math> cm.</p>  <p>a. What information did you get from the situation?</p> <p>b. What is the relationship between the circle problem the? Explain why you chose it!</p> <p>c. From the information you have know , conclusion What is you got about the bow that ?</p> <p>d. How are the steps to do for Determine the length of the arc of circle AB the? Explain your answer!</p> <p>e. If Mrs. Dwi solves the problem above with the answer, the length of the CD is 56 cm. Do you agree with Mrs. Dwi's opinion? Include your reasons!</p> |

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