EMTEKA: Jurnal Pendidikan Matematika
Volume 6, No. 1, 2025. 215-225
DOI: https://doi.org/10.24127/emteka.v6i1.5872

e-ISSN 2746-5594
p-ISSN 2746-5608

DEVELOPMENT OF FLIP-ASSISTED E-MATH MAGAZINE PDF CORPORATE USING PBL MODEL TO IMPROVE CRITICAL THINKING ABILITY

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Received February 05, 2025; Received in revised form February 20, 2025; Accepted March 15, 2025

ABSTRACT
This research was conducted to develop E-Math Magazine assisted by FLIP PDF Corporate using the Problem Based Learning (PBL) model to improve the critical thinking skills of class IX B SMP Negeri Satu Atap Sungai Bertam. This research uses the Research & Development (R&D) research type. This research uses the ADDIE development model, namely: Analysis, Design, Development, Implementation, and Evaluation. The conclusion of this research is made through data analysis conducted using qualitative data and quantitative data. The results of the research obtained were stated to be very valid in terms of material (validity level 86.36%), very valid in terms of media design (validity level 86.11%), very practical (practicalization level 95% in individual trials and 92.75% in small group trials), very effective based on student responses (student response effectiveness level 98.07%), very effective based on student learning completeness (learning completeness level 100%), and effective in improving students' critical thinking skills (average N-Gain 80%).
Keywords: addie; critical thinking; e-math magazine; pbl

ABSTRAK
Penelitian ini dilakukan untuk mengembangkan E-Math Magazine berbantuan FLIP PDF Corporate menggunakan model Problem Based Learning (PBL) untuk meningkatan kemampuan berpikir kritis kelas IX B SMP Negeri Satu Atap Sungai Bertam. Penelitian ini menggunakan jenis penelitian Research & Development (R&D). Penelitian ini menggunakan model pengembangan ADDIE yaitu: Analysis, Design, Development, Implementaition, dan Evaluation. Kesimpulan dari penelitian ini dibuat melalui analisis data yang dilakukan dengan meggunakan data kualitatif dan data kuantitatif. Adapun hasil penelitian yang diperoleh dinyatakan Sangat Valid secara materi (tingkat validitas 86,36%), sangat valid secara desain media (tingkat validitas 86,11%), sangat praktis (tingkat praktikalisasi 95% pada uji coba perorangan dan 92,75% pada uji coba kelompok kecil), sangat efektif berdasarkan respon peserta didik (tigkat efektifitas respon peserta didik 98,07%), sangat efektif berdasarkan ketuntasan belajar peserta didik (tingkat ketuntasan belajar 100%), dan efektif meningkatkan kemampuan berpikir kritis peserta didik (Rata-rata N-Gain 80%).
Kata kunci*: addie; berpikir kritis; e-math magazine; pbl*

Introduction

Education is a very influential thing in improving the quality of life of a nation because the role of education is to prepare human resources who will become actors in

e-ISSN 2746-5594
p-ISSN 2746-5608

the progress of the nation. Learning is a process carried out by individuals to obtain a new change in behavior as a whole, as a result of the individual's own experience in interaction with the environment (Pane & Dasopang, 2017). Learning is carried out in order to achieve the goals of education, among others, so that students have curiosity, do not easily give up, have an interest in learning, and have confidence and do not depend on others in solving a problem (Suwoto, 2015).

Mathematics is one of the branches of science that is a study in the 2013 curriculum which is taught starting from elementary school to college education. This statement is in line with Rafiqoh (2020), which states that mathematics is studied from elementary school to college. Mathematics is also said to be a field of science that examines rational ways of thinking related to existing science, such as the existence of number patterns, formulas, and the logic that covers them (Yuliza et. al, 2024).

According to Kresma (2014), mathematics is a means of scientific thinking which is very necessary in developing the ability to think logically, systematically, and critically in students to support the success of students' learning. In addition, mathematics is known as a deductive science, which means that the process of working on mathematics must be deductive. The application of this deductive way of thinking will produce theorems which are then used to solve problems both in pure mathematics and in applied mathematics (Sulistiani & Masrukan, 2016). Thinking skills, both critical and creative thinking, are very important for education. According to Syam (2020), the development of human resources that are critical, creative and have problem-solving skills will create a superior generation.

In learning, students must be able to solve problems and solve math problems. Students are also required to have calculation skills and the ability to understand mathematical concepts which will greatly affect student learning outcomes. Indah (2020), states that students must have the ability to think critically in the field of mathematics to be able to face the challenges of life in the era of the industrial revolution 4.0, especially in the field of education. In line with this statement Tanjung (2019), critical thinking is a person's ability to obtain information correctly, evaluate and process the information into a decision.

Another thing that also supports the success of mathematics learning is the selection of appropriate learning resources that aim to support the learning process. This statement is in line with Daryanto (2016), which states that one of the important components in the learning system is learning media. According to Masudah & Syukur (2021), learning resources are anything that can make it easier for students to obtain a number of information, knowledge and skills in the learning process. Prastowo (2014), mentions the forms of learning resources, namely: books, brochures, posters, encyclopedias, movies, magazines, videos, models, the internet, study rooms, and so on. One of the learning resources that can be used in the learning process is magazines. Which is useful for presenting actual reading, containing the latest data that attracts attention, enriches the treasury of knowledge, and increases student interest in a problem.

Over time, print media has become electronic media. Electronic magazines are electronic versions of printed magazines because they are application-based. electronic magazines (e-magazine) are used in digital form that can be accessed on electronic media such as laptops, computers, Android smartphones, iPhone, iPad, and other technologies. In the subject of mathematics, the electronic magazine of mathematics is called Mathematics Magazine or Mathematics-Magazine (E-Math Magazine). In line

e-ISSN 2746-5594
p-ISSN 2746-5608

with today's technological developments, the E-Math Magazine can be developed using the flif PDF Corporate application which can provide a more attractive appearance and additional content so that it makes it easier for teachers to deliver material and can encourage students to do enrichment independently with links to other learning resources. Through this media, students can clearly see images/photos, graphics, audio, animation and video that are digitally created (Rusli & Supuwiningsih, 2017).

According to Supriyadi, et all, (2018) the advantages of e-magazine learning resources using flip creator are that they can load files in the form of videos, links, moving animations, images and sounds. Flipbook media can be an attraction so that students' attention will be focused on the learning process and as an effort to increase learning motivation (Muryati, et.al., 2023).This of course will be very helpful in the learning process, so that students are not bored or bored in the learning process. According to Fuad et al., (2020), e-magazine learning resources using flip creator can be said to be an innovative learning resource because it contains several additional features such as learning videos, color images, animations, writing that is not monotonous, and unique information that can attract students' attention to read and learn the material contained in the e-magazine learning resources.

Besides the learning resource factor, the selection of learning models is also a factor that plays a significant role in the success of learning. The mathematics learning model that can be used is a learning model that applies the involvement of students to be active in learning mathematics, one of which is the Problem Based Learning (PBL) learning model. By using the PBL learning model, students are required to be more active in finding problems and solving problems through the ideas they explore (Pranoto et.al., 2017). Polya (1973), suggested four steps of problem solving, namely understanding the problem, developing a solution plan, implementing the solution plan, and re-examining the answer.

Based on initial observations, it was found that the critical thinking skills possessed by students of class IX B SMP Negeri Satu Atap Sungai Bertam were still low. One solution that can be done to overcome this problem is to develop ICT learning media that can be used for learning. The solution was taken based on studies that have been published by previous research, namely according to Pradista (2022), the product of developing a social arithmetic e-magazine was proven effective for improving mathematical critical thinking skills in the research sample in terms of the average pretest and post-test results. Another research that also supports this theory is Nahriyah (2023), who succeeded in proving that the problem-based learning-based e-book on environmental change material developed is able to train the critical thinking skills of grade X high school students. In addition, research by Astuti (2022), also proves that the e-magazine media used is very effective and can improve students' higher order thinking skills.

So based on the explanation above, researchers are interested in conducting research with the title “Development of Flip-Assisted E-Math Magazine PDF Corporate Using PBL Model to Improve Critical Thinking Ability”.

Research Methods

This research was conducted in Class IX of SMP Negeri Satu Atap Sungai Bertam consisting of 23 people who were used as research samples. This research was conducted in the even semester of the 2023/2024 academic year. This study uses the type of research and development R&D (Research & Development). Borg and Gall

e-ISSN 2746-5594
p-ISSN 2746-5608

(1983) define development research as a process used to develop and validate educational products. According to Haviz (2016), development research is a systematic study of designing, developing and evaluating products as a solution to problems in education.

The development model used in this research is the ADDIE development model developed by Branch (2009). There are five stages in the ADDIE development model, namely: Analysis, Design, Development, Implementation, and Evaluation. The following are details of the development procedures applied in this study: At the Analysis stage, researchers analyzed the real conditions that occurred in the mathematics learning of class IX SMP Negeri Satu Atap Sungai Bertam. The activities at the analysis stage are: validating performance gaps; setting instructional objectives; identifying learner characteristics; identifying resources; and determining appropriate learning strategies.

Furthermore, at the Design stage, the activities carried out by researchers are to create a design which will then produce a product in accordance with the media flowchart. Furthermore, an electronic magazine (e-Magazine) was designed with the Problem Based Learning (PBL) learning model to improve the critical thinking skills of grade IX students on the material of curved side space building. Media design is carried out using the Canva Professional application with the Story board of the developed media design. In the third stage, namely Development, the activities carried out by researchers are product manufacturing, product validation, product revision, individual trials, small group trials, and field trials. Furthermore, the Implementation stage is carried out to determine the effectiveness of the e-math magazine that has been developed and its effect on improving the critical thinking skills of students in class IX B SMP Negeri Satu Atap Sungai Bertam with the material used is the curved side space that has been declared valid and practical by a team of experts. The last stage carried out is Evaluation. At the evaluation stage, the e-math magazine assessment stage is carried out by the user. After the learning media assessment stage is carried out by educators and students, the research data is obtained, then the data is analyzed using qualitative and quantitative data so that from the data it can be concluded that the learning media is feasible or not feasible to use in the learning process.

The type of data taken in this study is qualitative data and also quantitative data. The data sources in this study are validation instruments, student response questionnaires, and analysis of students' critical thinking skills. To determine the research subject, 3 (three) trials were conducted. The first trial was an individual trial on mathematics educators. The second trial was a small group trial consisting of 9 students in class IX B. The third trial was a field trial on class IX B students totaling 23 people as well as testing the implementation of media in learning. The data collection instruments used were closed questionnaires and tests that had been validated by a team of experts.

The data analysis technique consists of media validity data obtained from research in the form of validity questionnaires processed for further descriptive analysis by calculating the percentage obtained. Practicality data In the practicality test, a questionnaire is used which is given to educators and students with a closed questionnaire type with answers in the form of a scale to measure the respondent's opinion as a questionnaire answer. The effectiveness of the media products developed can be seen from the students' response questionnaire and the total score of students' critical thinking skills. The data analysis technique is calculated using a Liker t scale, which is as follows:

e-ISSN 2746-5594
p-ISSN 2746-5608

4 = Very effective / very good
3 = Effective/good
2 = Not effective/ not good
1 = Not very effective/ not very good

Data analysis of the improvement of students' critical thinking skills used the Gain (N-Gain) test. According to Sukarelawan et.al (2024), the N-Gain test is a commonly used method to measure the effectiveness of a learning or intervention in improving student learning outcomes. The increase in students' critical thinking skills is taken from the pretest and post-test scores obtained by students. The following is the percentage that is the basis for seeing the effectiveness of action on learning with criteria as in Table 1. below:

Table 1. Criteria for determining the effectiveness level

Percentage (%)	Criteria
<40	Not Effective
40 – 55	Less Effective
56 – 75	Moderately Effective
> 76	Effective

The minimum limit of instruments in the form of learning media in this study is said to be effective for use in the learning process if the Gain score is obtained with at least moderate criteria and the N-Gain percentage of the critical thinking ability test results with effective criteria.

Results and Discussion

In this section, researchers describe the results of the research conducted and the appearance of the products produced, as follows:

Development Results

The development procedures made based on the ADDIE development model that have been implemented, are as follows:

Analysis Phase (Analysis)

At the analysis stage, learners conduct interviews with educators to analyze work gaps. The results of the analysis obtained by the researcher are more directed to the lack of information provided in the teaching process carried out by both educators and students. Furthermore, researchers conducted an analysis of the instructional objectives carried out. Where the results of the analysis lead to the development of learning media that is more suitable for use in the current era of globalization, namely electronic learning media.

After seeing an agreement regarding the media to be developed, the researcher finally determines the resources that can help during the research process, both human resources, and the technology that will be used. Beyond that, researchers also prepare learning strategies that allow use of the media used in learning.

Planning Stage (Design)

At this stage, researchers make designs related to the media that will be carried out. Researchers use canva technology guided by the flowchart and story board that has been made before. The use of canva is done with the aim of making it easier for researchers to design the form of learning media to be made. The electronic media

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p-ISSN 2746-5608

made by researchers includes the existence of E-Math Magazine learning media assisted by Flip PDF Corporate using the Problem Based Learning (PBL) Model. The following is presented in Figure 1. regarding the appearance of the media overview used, namely:

Figure 1. Overview of the Media Used

Furthermore, for the table of contents made in electronic learning media designed like a magazine, the table of contents page is titled "TABLE OF CONTENTS". This page is designed using the Magazine in White Light Blue Seafoam Green Minimal Type-Driven Style 2 template with a background change in the form of a golden crackers image. The description of the table of contents in the electronic learning media made is presented in Figure 2. below:

Figure 2. Image of Table of Contents of Media Used

Furthermore, in the design section of the teaching materials made, researchers designed the tube material by dividing it into 3 (three) main sections according to the development title, namely using the Problem Based Learning (PBL) Model, Critical thinking and Problem Exercises. The display can be seen in Figure 3. below:

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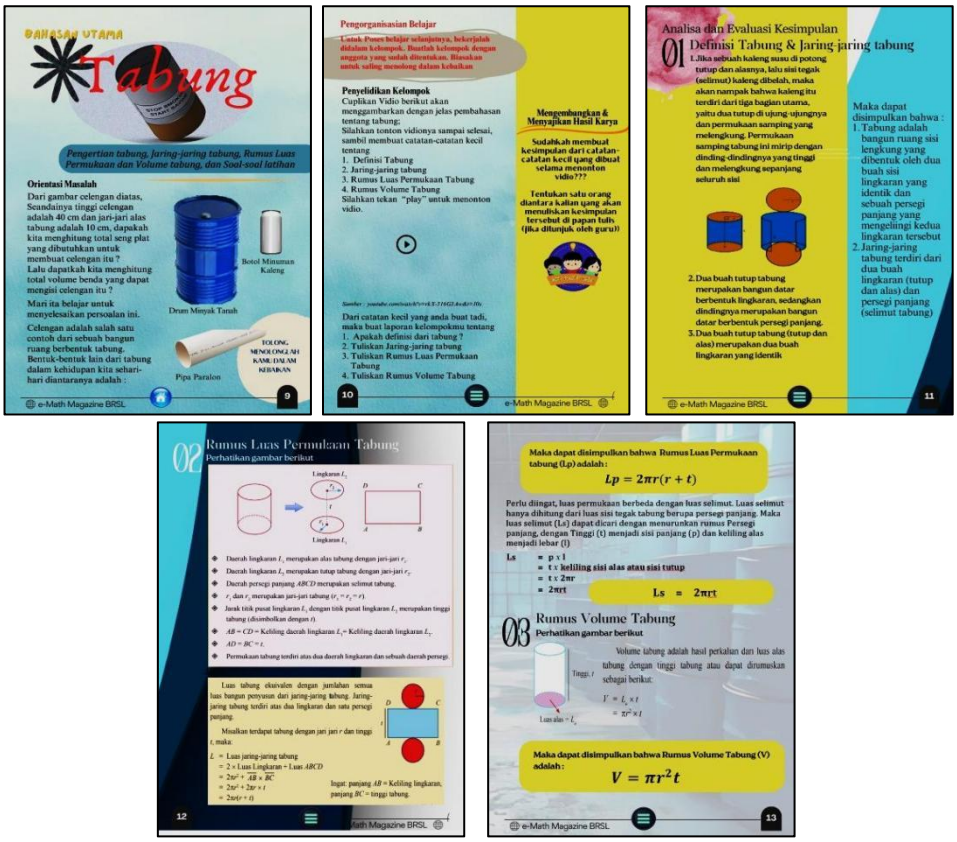

Figure 3. PBL Page Display of Tube Material

In critical thinking skills, researchers describe into 2 pages which are sorted based on indicators of critical thinking skills. The technique used in encouraging this critical thinking ability is to direct students in solving problems contained in the problem orientation phase. Media designed related to critical thinking skills are described in Figure 4. below:

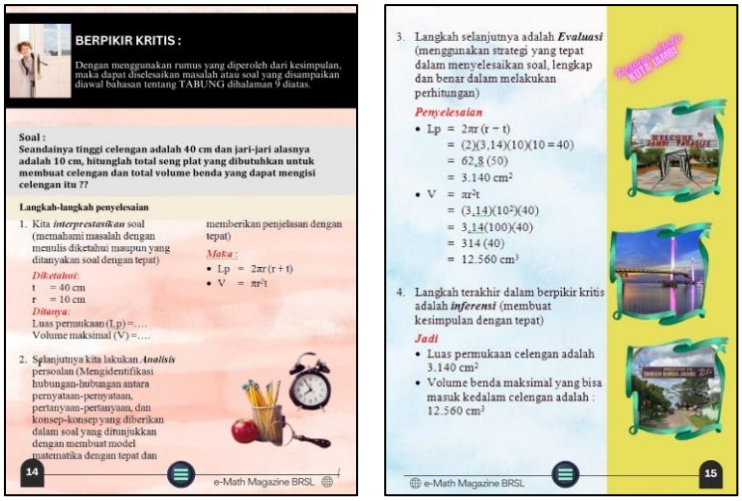

Figure 4. Critical Thinking Page Display

In the closing section, the media design carried out by researchers is the provision of practice questions and daily tests conducted online. The page is made with the basic template White Clean Minimalist Fashion Magazine Article Page 14. The script is

e-ISSN 2746-5594
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designed to make the STAR button to be connected to the google form and Barcode which when scanned will also be connected to the google form link. The appearance of the daily test page is presented in Figure 5. below:

Figure 5. Online Daily Review Page

1. Development Stages (*Development*)

The development stage starts from making media which includes: making media assisted by Flif PDF corporate is done by converting designs made in canva into PDF format. After the media design is available in PDF form, then proceed with making media with Flif PDF Corporate. So that the media made can be accessed on an android smartphone, the project file has been published converted to .apk format using the Website 2 APK Builder Pro application. After the learning media carried out is in the finishing stage, the researcher then validates all research instruments used in the learning media, both descriptions related to the media design made, as well as the teaching materials used. Furthermore, researchers also conducted practicality trials starting from individual trials and small group trials.

2. Implementation Stage (*Implementation*)

The implementation stage aims to determine how the effectiveness of mobile learning media that has been developed can support the improvement of students' critical thinking skills in learning. The implementation stage was conducted nine times, namely the pre-research meeting, the first meeting to the eighth meeting of learning. Based on the meeting, it was concluded that the media used was very effective with an effectiveness level of 98.07%, this was seen based on the students' response to the media used.

3. Evaluation stage (*Evaluation*)

This evaluation stage is the last stage of the ADDIE development method. At this stage, researchers conduct a comprehensive evaluation of all previous stages with the aim of knowing how much influence the e-math magazine product produced through the level of validity, practicality, and effectiveness. The final results of the evaluation state that the media is valid, practical, and effective for use in learning in class IXB SMP Negeri Satu Atap Sungai bertam on the material of Curved Side Spaces.

Discussion

1. E-Math Magazine Development Results

Based on the specifications of the products produced and after being tested, it is known that the media can be operated offline on Android Smartphones with low

e-ISSN 2746-5594
p-ISSN 2746-5608

specifications at low prices such as Xiomi Redme A2 and the like which are still relatively affordable by students. In addition, the media used can be operated offline, so it does not require an internet signal to operate. Internet signal is only needed when sending and installing applications to android smartphone devices.

2. Quality of E-Math Magazine

The quality of the media was assessed by two validators who have expertise in their fields. The results of instrument validation conducted by validators on the learning materials used are said to be very valid and can be used without correction. The results of instrument validation carried out by validators on the learning media developed were declared very valid and suitable for use without correction with a validity level of 86.11%.

After going through the validation process and declared feasible to use without correction, the practicalization test of the learning media developed was carried out. The recapitulation of the results obtained during the individual trial on the learning media that has been designed shows that the media used is very practical and can be used without revision. For the small group trial, the percentage of media practicality obtained was 92.75%, where the average achievement was 33.39 out of a maximum of 36. Based on this data, it was concluded that in the small group trial the media was declared very practical with a practicality level of 92.75%.

After the practicality test is carried out, the media is tested into a large group and used in learning with the aim of seeing the effectiveness of the media in terms of learner responses, completeness and learning outcomes and increasing students' critical thinking skills. The response obtained from students to learning media is classified into very effective criteria with an average achievement of 98.07%.

Furthermore, learning completeness is measured from students' post-test scores where in this study students' scores are measured based on critical thinking indicators. In this study, the class average score was 86.21 (very effective), and the number of students who reached the KKM (score> 75) was 23 people (100%). The average percentage of students' critical thinking skills is also in the effective to very effective range ($60 < E < 100$). Based on the results of the achievement of learning completeness, it can be concluded that the media is very effective to be used to improve students' critical thinking skills.

The results obtained in this study indicate that there is an increase in students' critical thinking skills after using learning media in the form of E-Math Magazine assisted by Flip PDF Corporate using the Problem Based Learning (PBL) Model. Through this study, it was also found that the effectiveness of using E-Math Magazine learning media assisted by Flip PDF Corporate using the Problem Based Learning (PBL) Model was effective for improving the critical thinking skills of Class IX B students of SMP Negeri Satu Atap Sungai Bertam in the material of curved side space as evidenced by the average value of the N-Gain percentage of students is 80%. The findings obtained are in line with the findings of Nahriyah (2023), who also succeeded in proving that the problem-based learning-based e-book on environmental change material developed is able to train the critical thinking skills of grade X high school students. In addition, research by Astuti (2022), also proved that the e-magazine media used was very effective and could improve students' higher order thinking skills.

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p-ISSN 2746-5608

Conclusion and Suggestion

The conclusion of this study is that the E-Math Magazine learning media assisted by Flip PDF Corporate using the Problem Based Learning (PBL) Model to improve the critical thinking skills of class IX B students of SMP Negeri Satu Atap Sungai Bertam is declared very valid in material (validity level 86.36%), very valid in media design (validity level 86.11%), very practical (practicalization level of 95% in individual trials and 92.75% in small group trials), very effective based on students' responses (effectiveness level of students' responses 98.07%), very effective based on students' learning completeness (learning completeness level 100%), and effective in improving students' critical thinking skills (average N-Gain 80%).

The suggestions from this study are the limitations of research that was only conducted in one class IX from one school as a sample. To get maximum results, other researchers can conduct a broader study by involving many sample classes from various schools so that the research results can be generalized more broadly.

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