PARADIKMA JURNAL PENDIDIKAN MATEMATIKA
ISSN: 1978-8002 (Print)
ISSN: 2502-7204 (Online)

Development of Media E-Comics Mathematics-Based Problem-Based Learning to Improve Problem-Solving Skills

Nia Irmaya[1*]

[1]Departement of Mathematics Education, State University of Medan, Indonesia
[*]Corresponding Author: niairmaya55@gmail.com

Article History:
Received : 02-08-2024
Revised : 02-10-2024
Accepted : 9-12-2024
Online : 9-12-2024

Keywords :
Media E-Komik; Problem Based Learning; Kemampuan Pemecahan Masalah

ABSTRACT

According to the initial observation in SMP Muhammadiyah 16 Lubuk Pakam, there are educators who have not fully exploited the design, development, and utilization of media, particularly e-comics media that have never been implemented. Additionally, pupils who are still lacking in problem-solving abilities. (1) Creating legitimate, workable, and effective e-comics medium is the goal of this project, and (2) to evaluate the enhancement of problem-solving abilities through the use of e-comics media that are PBL. The ADDIE model was implemented in this investigation. Seventh-grade pupils from SMP Muhammadiyah 16 Lubuk Pakam participated in this investigation. Instrument utilized in the development of e-comics media, including lesson plans, LKPD, and problem-solving ability assessments. The study's findings indicate that the media e-comics satisfy the valid criteria with a score of 4.69, subsequently conducted trials to develop a practical and effective media that satisfies the practical criteria with a score of 88.95, and satisfy the effective criteria with a score of 87.79On average, the N-gain for the medium group was 0.33 when the problem-solving ability was assessed from N-gain to the development trials. In the high category, the average N-gain was 0.73 when the problem-solving ability was measured against posttest I and posstest II. The e-comic media PBL is capable of enhancing the problem-solving abilities of students at SMP Muhammadiyah 16 Lubuk Pakam, as indicated by the N-gain results.

Keywords: E-Comic Media; Problem Based Learning; Problem Solving Ability;

A. INTRODUCTION

According to the National Education System Law No. 20 of 2003, the goal of public schooling across the country is to help students realize their potential so they can become honorable, knowledgeable, capable, creative, independent, fearful of God Almighty, and responsible, democratic citizens. This foundation serves as the primary basis for implementing learning in any field of study, including the field of Secondary School Mathematics (Hendriana, 2014).

Mathematics basically teaches learners about the logic of thinking based on reason and reason. However, it must be remembered that basically the nature of mathematics is abstract and not real because it consists of many symbols. These things make learners less fond of mathematics. The way of thinking of students in the current era still tends to be at the cognitive stage, which means that if students are given a mathematical concept, it must be accompanied by real examples so that students do not have difficulty understanding it.

Of the various important factors that support the ability of students to learn mathematics, there is one important factor to be taken into consideration in teaching, namely using various sources and Learning media. The most important place for learning media in a system of learning is at the top (Daryanto, 2016). There are two major functions that media perform in the context of education and learning: (1) media used

as an instructional tool, often called dependent media because of its usefulness in this context, and (2) media used as a resource for independent learning, often called independent media.

The results of the interviews and observations that were done at SMP Muhammadiyah 16, stated by one of the residents of the school, including teachers, convey the difficulty of teachers in operating learning media, especially teachers who are elderly. And as for teachers who are in the young age category and are very capable in the development of media creation, but have not yet used interactive media, only using exposure to material from youtube. They reasoned that, there has been no special training to make interesting media organized by the school.

One of the media chosen in the above exposure is E-comic media. Responding to these problems, comic media can be used as a solution to solve problems in mathematics learning. Another reason for the development of comics as a learning medium, because this media is very familiar with the world of children seen the target of the study is the seventh grade students who are still aged in the age range of 11-13 years . At the age of VII grade students are still carried away DIBANGKU elementary school, then the comic is still considered to attract their attention. It is undeniable that students in the seventh grade of SMP Muhammadiyah 16 Lubuk Pakam are more happy and interested in learning something that is pictorial, fun, funny, and interesting. With developed comic appreciation media in learning can increase interest in reading and better understand math lessons.

Problem Based Learning (PBL) which focuses the existence of a problem that students face in learning (Rosmala, 2018). The problem is used as a starting point in building a concept. The chosen problem is a problem that comes from the daily lives of students to facilitate pupils' understanding of the content being taught. When problem-based learning is used, student activities may be maximized and all student activities in the classroom can be organized according to the actual stages of learning. (Rohati, 2013). So that learners are trained to think at a high level and develop personality through problems in everyday life.

B. RESEARCH METHODS

A development model, often known as research and development (R&D) in English, is used in this study. Research development is an approach to research that is used to generate specific products and evaluate their efficacy (Sugiono, 2015:407). This study's creation makes use of the ADDIE model. Following the acronym, the five steps in this paradigm are as follows: 1). Analyze is the process of examining students' needs in order to determine what problems need fixing, how to fix them, and how competent students are. 2). Design is designing e-comic media using *pixton web* application and combining comic characters and dialogues in Ms.word .3). Development is testing the development with the stage of practicality trials and effectiveness trials. 4). Implementation is to carry out the implementation test after the e-comic media has been declared valid, practical, and effective. 5). Evaluation is to analyze each stage of ADDIE, specifically, assessment across the phases of analysis, design, development, and implementation.

Students from Classes VII A and VII B at SMP Muhammadiyah-16 Lubuk Pakam, each with 32 participants, served as the study's subjects in 2023–2024. While using e-comics-based media for Problem Based Learning (PBL) to help students become more adept at addressing problems pertaining to the set's material operations.

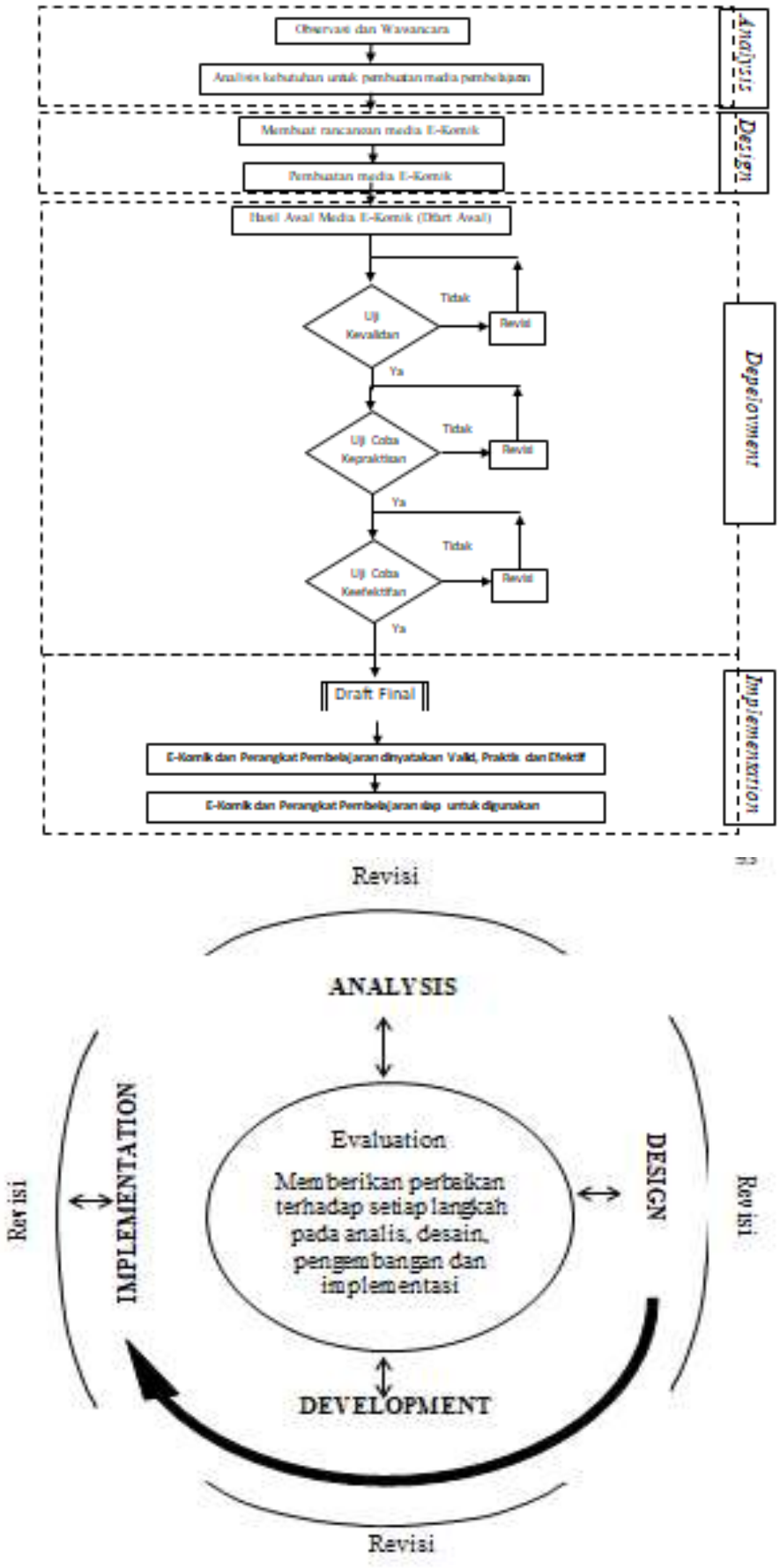

Figure 1. PBL-based e-comic Media Development procedure

This study's data analysis aims to address the efficacy, viability, and validity of the produced e-comics medium. The data analysis in this study is described in full below:

(1) validity Data analysis of E-comic Media

An examination of the validity data of e-comic media was carried out by five validators who evaluated the e-comic media using the expertise of media professionals and material specialists. Validators create evaluations for educational materials, examinations to measure problem-solving skills, and questionnaires to gauge student enthusiasm in learning. Assessment data from experts and practitioners determined the average value of indicators and aspect values for each expert and practitioner. From the results of the value for each aspect can be determined the average value of the aspect, in order to find the mean value of the overall aspect. Finding out how valid the learning media model is in terms of all the evaluation criteria The procedure for problem-based learning is as follows:

a. recapitulate the learning media's validity assessment data into tables with the following information: aspects (A_i), indicators (I_i), and V_{ji} values for each expert.
b. b. Use the formula to find the expert's average value for each indication:

$$I_i = \frac{\sum_{j=1}^{m} V_{ji}}{n} \qquad (Susanto, 2012)$$

Description :
V_{ji} = Valuable information from the j assessment of the i indicator
n = many assessments (Professionals and specialists)

c. determine the formula's average value for every factor:

$$A_i = \frac{\sum_{j=1}^{m} I_{ij}}{m} \qquad (Susanto, 2012)$$

Description :
Ai = is the i aspect's average value.
Iij = is the i aspect of the j indicator's average.
m = the quantity of indications in the aspect i
The outcomes are subsequently recorded in the relevant table columns.

d. d. Calculate Va, or the average of all variables, using the available formula:

$$V_a = \frac{\sum_{i=1}^{n} A_i}{n} \qquad (Susanto, 2012)$$

Description :
Va = total average value for all aspects
A_i = average value for the i aspect
n = number of points
After that, the data is input into the appropriate columns of the tables.

Moreover, the interval used to assess the validity of the Learning Media Model Problem Based Learning (Susanto, 2012) is denoted by the value of Va, or the total average value, as shown in Table 1 below:

Chart 1. Criteria For The Level Of Validity

No	*Va or total mean value*	Validity Criteria
1	$1 \leq Va < 2$	Invalid
2	$2 \leq Va < 3$	Less valid
3	$3 \leq Va < 4$	Quite valid
4	$4 \leq Va < 5$	Valid
5	$Va = 5$	Very valid

Detailed description:
Va = the significance of assessing the reliability of educational resources on Problem-Based Learning model.

(2) Data Analysis of e-comic media practicality

Data analysis of e-comic media practicality based on the implementation of learning, and the response of teachers and students. The exposure as follows:

a. the learning process

Data on the use of e-comics Learning media is collected using this tool. Two observers who have received prior training are tracking the installation of e-comic learning medium. This allows them to accurately complete the observation sheet. Additionally, the following method is used to categorize the score as a percentage of overall implementation.

$$k = \frac{average\ score}{average\ maximum\ score} \times 100\%$$

In addition, the value of applying Problem-Based Learning is connected to the interval used to determine the degree of media application, as indicated in Table 2 below (Sudjana, 2005):

Chart 2. Percentage Of Learning Implementation Qualifications

Percentage Of Implementation	Categories
$k \geq 90$	Very Good
$80 \leq k < 90$	Good
$70 \leq k < 80$	Enough
$60 \leq k < 70$	Less
< 60	Very Less

Description: k = implementation of Learning media

b. analysis of teacher and student response data.

if the proportion of students who provide positive answers exceeds or equals 80% of the total number of subjects studied for each trial, then the learning objectives have been met. The formula in Trianto (2011) is used to determine the proportion of response from teachers and students:

$$PRG = \frac{\sum A}{\sum B} x\ 100\% \qquad PRS = \frac{\sum A}{\sum B} x\ 100\%$$

A = proportion of students / teachers who responded positively

B = number of students / teachers who responded

If the percentage of students who gave positive responses for each of the several trial subjects is at least 80%, then teachers and students meet the established criteria for responding favorably to e-comic media. (Sinaga, 2007).

Chart 3. Response categories of teachers and students in learning activities

No	Percentage Teacher Response and Students Response (%)	Categories
1.	81 – 100	Very Good
2.	61 – 80	Good
3.	41 – 60	Enough Good
4.	21 – 40	Not Good
5.	0 – 20	Not Very Good

Modified Ruseffendi (in Azwar, 2017)

(3) Analysis of e-comic Media effectiveness Data

Analyzing the efficiency of e-comic media using traditional methods such as assessing student learning completeness, objective success, and interest.

a. Analysis Of Student Learning Completeness Classically

To determine the completeness of the results of the students ' knowledge of problem-solving ability test (TKPM) can use the following equation Trianto (2011:

$$Learning\ Mastery = \frac{total\ score\ obtained}{total\ initial\ score} \times 100$$

Whereas the percentage of students who completed individually is used to determine the percentage of classical completeness (PKK), or the completeness of learning per class. A class is considered to have finished learning if PKK ≥ 85% of the total number of students who have completed the exam of problem-solving skills is reported. The percentage can be calculated by the formula :

$$PKK = \frac{number\ of\ completed\ students}{total\ number\ of\ students} \times 100\%$$

Categories of students ' problem solving ability levels can be seen in Table 4 as follows :

Chart 4. Category level of problem solving ability

No.	Reach	Qualitative Value
1	90 ≤ KPM ≤ 100	Very High
2	80 ≤ KPM < 90	High
3	70 ≤ KPM < 80	Enough
4	60 ≤ KPM < 70	Low
5	0 ≤ KPM < 60	Very Low

The criteria stipulates that 85% of test-takers must obtain a minimum issue-solving score of 75 in order for pupils to be considered to have solved the problem. (Trianto, 2011).

b. Analysis Of The Achievement Of Learning Goals

The formula was used in the problem-solving ability test to determine if the learning objectives of each item were met:

$$T = \frac{total\ score\ for\ item\ i}{total\ score\ max\ for\ item\ i} \times 100\% \qquad (Fauzi, 2002)$$

The standards are:

If 0% ≤ T < 75%, then the learning objectives are not met.

Learning objective attained if 75 ≤ T ≤ 100.

(4) Data Analysis Improved Problem-Solving Capabilities

Data from the test results were examined to determine the extent to which the students' problem-solving abilities have enhanced. By comparing the test results of students before and after receiving treatment, the scores that students received before and after using learning media that have been generated are assessed. The N-gain formula from Hake (1999) determines the size of the increase before and after learning as follows: Utilizing the gain index standards shown in Table 6 below:

Chart 6. Normalized Gain Score Criteria

Skor Gain	Interpretation
$g > 0{,}7$	High
$0{,}3 < g \leq 0{,}7$	Medium
$g \leq 0{,}3$	Low

C. RESULT AND DISCUSSION

Based on results of the development of e-comics media then find the following results :

(1) validity results of e-comic Media

Table 8 displays the average total acquired by experts and practitioners based on their assessment results.

Chart 8. Validation Results Of E-Comic Media By Experts

No	Valdity Aspect	Average Total (Va)	Validity Criteria
1	Media E-komik		
	a. Members Of The Media	4,69	Valid
	b. Material Expert	4,70	Valid
2	RPP	4,62	Valid
3	LKPD	4,73	Valid

(2) Development Test Results

Development experiments on the usefulness and efficacy of e-comic media were carried out based on the findings of field research. The development trial summary results are shown below :

Chart 9. Practicality Results On Trial I

No	Aspects Of Practicality	Average	Categories	Conclusion
1	Learning Implementation	78,89	Enough	Not Yet Practical
2	Teacher Response	86,56%	Very Good	Practical
3	Student Response	86,69%	Very Good	Practical

Then the e-comic media conducted trials on the effectiveness of the first obtained results as follows :

Chart 10. Results Of Effectiveness In Trials I

No	Aspects Of Effectiveness	Average	Kategori	Kesimpulan
1	Classical Completeness	50%	Low	Not Yet Effective
2	Achievement Of Learning Objectives	86,64%	Achieved	Effective

Based on Table 10, there are criteria of practicality and effectiveness that have not been met, namely the implementation of learning and classical completeness. This is a reference to make improvements to learning by improving the media according to the indicators' deficiency in terms of learning implementation and classical completeness. So, in the trial i e-comic media has not been said to be practical and effective. Furthermore, the second trial was conducted to repeat the learning by taking into account the weak indicators in the implementation of learning and classical completeness. Then the results of the second trial as follows :

Chart 11. Practicality results in trial II

No	Aspects Of Practicality	Average	Categories	Conclusion
1	Learning Implementation	88,21%	Good	Practical
2	Teacher Response	87,94%	Very Good	Practical
3	Student Response	90,75%	Very Good	Practical

Then the e-comic Media conducted trials II on the effectiveness of the results obtained as follows :

Chart 12. Effectiveness results in trial II

No	Aspects Of Effectiveness	Average	Categories	Conclusion
1	Classical Completeness	94%	Very High	Effective
2	Achievement Of Learning Objectives	92,03%	Achieved	Effective

(3) Implementation Test Results

Based on the efficacy and feasibility of the e-comic media creation test results. E-comic media that utilizes Problem Based Learning (PBL) has been deemed legitimate, useful, and efficient. Additionally, Class VII A of SMP Muhammadiyah 16 continues to test the e-comic media, which is already in a legitimate, practical, and effective condition. The outcomes of this testing were as follows.:

Chart 13. Results of practicality and effectiveness in the implementation Test

No	Aspects Of Practicality	Average	Categories
1	Learning Implementation	96,67	Very Good
2	Teacher Response	91,27%	Very Good
3	Student Response	86,69%	Very Good
4	Classical Completeness	91%	Very High
5	Achievement Of Learning Objectives	90,62	Achieved

(4) Improved Problem Solving Ability

The development trial's enhancement of problem-solving abilities is explained as follows :

Chart 14. Improved troubleshooting capabilities of Prestest and Posttest I trials

N-Gain	Number Of Students	Interpretasi
$g > 0,7$	0	High
$0,3 < g \leq 0,7$	17	Medium
$g \leq 0,3$	15	Low
Average N-gain	**0,33**	**Low**

Chart 15. Improved problem solving capabilities of Posttest I and Posttest II trials

N-Gain	Number Of Students	Interpretasi
$g > 0,7$	15	High
$0,3 < g \leq 0,7$	16	Medium
$g \leq 0,3$	1	Low
Average N-gain	**0,729**	**High**

Additionally, the following enhancement of problem-solving abilities in the implementation test:

Chart 16. Improved problem solving skills in Test implementation

N-Gain	Number Of Students	Interpretasi
$g > 0,7$	12	High
$0,3 < g \leq 0,7$	19	Medium
$g \leq 0,3$	1	Low
Average N-gain	**0,66**	**Medium**

D. CONCLUSION AND SUGGESTIONS

Based on this research, the conclusion to answer the formulation of the problem is that e-comic media is said to be valid, practical, and effective by testing the validity and testing the development. In conducting development trials Students' ability to solve problems is improving.This is obtained from the N-gain of problem-solving ability of 0.729 in the high category. The following explanation concludes that PBL-based e-comics media can improve problem-solving skills.

E. ACKNOWLEDGEMENT

This time, the author would like to convey their appreciation and heartfelt gratitude to everyone who has helped them along the way: Supervisor I is Dr. Hermawan Syahputra, M.Si. Prof. Bornok Sinaga, M.Pd. is the head of the graduate study program in mathematics education, and Dr. Asrin Lubis, M.Pd. serves as supervisor II.

REFERENCES

Benny, A. P. (2010). Model Desain Sistem Pembelajaran. Jakarta: Dian Rakyat.

Brata, Sumadi Surya. (2013). *"Metodologi Penelitian"*. Jakarta: Rajawali.

Mujadalah, Ikhwatul , Alman dan Mukhlas Triono. (2021). *"Pengembangan Media Pembelajaran Komik untuk Meningkatkan Hasil dan Minat Belajar Matematika Peserta Didik Kelas IIISDMuhammadiyah Malawil"i*. Jurnal Papeda : Vol 3, No 1 Januari 2021.

Sinaga, B. (2007). *Pengemangan Metode Pembelajaran Matematika Berdasarkan Masalah Berbasis Budaya Batak (PBM-P3M)*. Disertasi. UNESA.

Slameto. (2006). *"Belajar dan Faktor-Faktor yang Mempengaruhinya"*. Jakarta: Rineka Cipta.

Adifta, Enggas Dinanti Dkk. (2020*). "Analisis Kemampuan Pemecahan Masalah Siswa Madrasah Tsanawiyah MTs Kelas VII Pada Materi Himpunan"*. Jurnal Kependidikan. 6(2): 341.

Ahmad, Marzuki dan Asmaidah, Seri. (2017). *"Pengembangan Perangkat Pembelajaran Matematika Realistik Untuk Membelajarkan Kemampuan Pemecahan Masalah Matematika Siswa SMP"*. Jurnal Mosharafa. 6(3): 374-375.

Alwi, Said. (2017). *Problematika Guru Dalam Pengembangan Media Pembelajaran*. Jurnal Itqan, Vol. 8 No. 2, Juli-November 2017.

Benny, A. P. (2010). Model Desain Sistem Pembelajaran. Jakarta: Dian Rakyat.

Brata, Sumadi Surya. (2013). *"Metodologi Penelitian"*. Jakarta: Rajawali.

Dwi F. Annisa, Dkk. (2017). *"Development Of Picture Media Based On Local Potency For Learning Materials Bopdiversity In Class X SMA 1 Pitu Riase Kab. Sidrap"*. Jurnal Pendidikan Dasar. Vol 4, No.2.

Eva Flora S, Roida. (2015). *"Pengaruh Minat dan Kebiasaan Belajar Siswa Terhadap Prestasi Belajar Siswa"*, Program Studi Pendidikan Matematika, Fakultas Teknik, Matematika dan Ipa Universitas Indraprasta PGRI.

Fadilah, Putri. (2018). *"Pengembangan Perangkat Pembelajaran Matematika Berbasis Realistic Mathematis Education (RME) Untuk Meningkatkan Kemampuan Pemecahan Masalah Pada Siswa Kelas VII SMP"*. Medan: Universitas Muhammadiyah Sumatera Utara.

Herlina, E. (2003). *Pembelajaran Matematika Realistik Pada Materi Luas di Kelas IV MI*. Tesis. Pascasarjana Program Studi Pendidikan Universitas Negeri Surabaya : Tidak diterbitkan

Hidayat, Adityawarman dan Irawan, Indra. (2017). *"Pengembangan LKS Berbasis RME Dengan Pendekatan Problem Solving Untuk Memfasilitasi Kemampuan Pemecahan Masalah Matematis Siswa"*, Jurnal Cendekia, 1(2): 53.

Ilyasa A, Rizqi. (2018). *Fungsi dan Jenis Media Pembelajaran Dalam Pembelajaran Akuntansi*. Jurnal Pendidikan Akutansi Indonesia, Vol. 16 No. 1, Juli 2018.