JPPS (Jurnal Penelitian Pendidikan Sains)
Homepage : https://journal.unesa.ac.id/index.php/jpps
Email : jpps@unesa.ac.id

p-ISSN : 2089-1776 ; e-ISSN : 2549-1597
JPPS, Vol. 11, No. 2, May 2022 : 166-179

Comics Problem-based Learning Model Implementation to Improve Students' Learning Outcomes on Heat and Its Transmission

Intan Dwi Safitri[1,*], Beni Setiawan[2], Muhamad Arif Mahdiannur[3]
[1,2,3]Universitas Negeri Surabaya, Surabaya, Indonesia

DOI : https://doi.org/10.26740/jpps.v11n2.p166-179

Sections Info
Article history:
Submitted: 30 April, 2022
Final Revised: May 25, 2022
Accepted: May 26, 2022
Published: May 29, 2022

Keywords:
Comics
Learning outcomes
Problem-based learning

ABSTRACT
This study aimed to improve student's learning outcomes on heat and its transmission using the comics problem-based learning model as an intervention program. This study used one group pretest-posttest design in the classroom natural setting. This study involved thirty-two students from 7th grade in one of the Public Junior High schools in the Sidoarjo Regency, East Java. Data were collected by using learning implementation observation forms, written test sheets, and students' response questionnaire forms. Based on the results of this intervention, we obtained a percentage of the lesson plan implementation at 94.12% at the first meeting and 93.38% at the second meeting with the very good category. The written test was used to pretest and posttest to measure the improvement in learning outcomes which got high normalized gain. The students' responses to the intervention were categorized as strong and positive. The result of this study shows that the implication of the comics problem-based learning model is effective to improve the students' learning outcomes, especially on heat and its transmission.

INTRODUCTION

The quality of a nation can be improved through education. The government continues to encourage the field of education in order to develop creative and innovative learning to build human resource excellence and of course the need for quality assurance of education (Ningrum, 2016). Various interventions and improvement efforts were carried out by the government to improve the quality of education in Indonesia, one of which was by increasing the public budget in the field of education (Chang et al., 2014). According to data from the Ministry of Finance, the government's efforts to improve education quality by increasing public spending in the area have had little influence in the last four years, specifically from 2015 to 2019, due to low student learning outcomes. Students can experience failure or low learning outcomes due to difficulty in understanding in learning, one of the subject is in natural science in Junior High School students (Haqiqi, 2018). Students assume that science is one of the difficult subjects, causing them difficulty understanding and lack of activity which has a low impact on learning outcomes (Yunarti, 2021).

Science is one of the learning that holds a full contribution to the progress of the development of science, knowledge, and technology to meet the demands of the 21st century, namely humans are invited to be able to think critically and creatively in problem-solving, innovate, elaborate, and communicate (Sujana, 2020). Natural science is more about observing natural phenomena or conducting experiments with the scientific method so that there is a need for an ability to innovate, think critically, and communicate in cooperation Sujana (2020). Character development can be accomplished using an innovative learning paradigm called problem-based learning (PBL), which provides students with an active learning environment (Fitria, 2022).

Problem-based learning supposes students to be active and involved in the process of learning (Sari & Rokhmani, 2019). The issue-based learning paradigm focuses on areas of study, inquiry, cooperation, producing work, and demonstrations in addition to question or problem solving (Cowden & Santiago, 2016). Problem-based learning is not meant to help teachers provide meaningful knowledge to students. Problem-based learning is learning that uses real unstructured and open problems as context for students to develop problem-solving and critical thinking skills as well as build new knowledge (Simamora & Manurung, 2021). Students collaborate in groups, engage, teach one another, and give presentations (Siahaan et al., 2021).

The characteristics of problem-based learning are as follows: problems as a starting point for learning, commonly used problems are problems of the world or everyday life, presented in an unstructured way, require a lot of perspectives, allow students to obtain new information, prioritizes students self-study, utilizes various learning resources (Kassymova et al., 2020). According to Aslam et al., (2021) PBL has five phases of learning: (1) Problem orientation for students; (2) Learning organization for students; (3) Guidance and investigation in group investigations; (4) Presenting the results of discussions and presentations; and (5) Analyzing and evaluating the problem-solving process.

Aslam et al. (2021) conducted a study on the PBL model to improve learning outcomes to investigate how it affected vocational students' learning outcomes. During the COVID-19 pandemic, the same study on problem-based learning models was undertaken to evaluate at the impact of the PBL model on accounting students' learning results (Imran et al., 2022). At the Student Association of Mathematics Education Study Program FKIP University of Riau, Indonesia the same study was undertaken to improve the logic of student learning outcomes (Syofni, 2019). Meanwhile, this study will be conducted to improve the learning outcomes of grade VII students a comics problem-based learning model implementation.

The PBL model can be implemented utilizing learning media since it has the potential to influence students' interest and motivation in participating in short-term learning activities (Rahmadita et al., 2021). One form of learning media used in this research is comics. Comics are usually in the form of sequential illustrated stories to convey information to readers (Mutiaramses & Fitria, 2022). Comics is one of the suitable image media to be applied in the learning process (Rahmi & Rahmati, 2020). This can be explained by the fact that kids find it simpler to absorb and remember information in books when they see and read illustrated stories (Sinta et al., 2021). The use of comics media that has a simple nature in the teaching and learning process with students will certainly attract more students in learning (Aulia et al., 2020).

Some of the results of study that has been conducted on how the influence of comics media on learning are as follows: comics media improves student learning outcomes and learning interests (Wandani et al., 2022), improves students' learning outcomes and communication skills (Dewantara, 2020), improves students' knowledge outcomes about disaster mitigation (Noviana et al., 2019), improves students' cognitive and affective learning outcomes (Rahmi & Rahmati, 2020), understanding the concept of Sumenep Private High School students on chemical bonding (Sinta et al., 2021), improving science literacy (Mutiaramses & Fitria, 2022), improving physics problem-solving skills in high school students (Annisa et al., 2020).

The study that has been done, proves that comics or comics books not only attract students' interest in learning but can also improve science learning outcomes. Comics media associated with the PBL model strategy will be able to make students more active in science learning which is invited to find solutions to real-world problems easily. One example of material in science learning is heat and its transmission, in which there are many applications of heat in everyday life. Cooking bandeng presto is one example of the application of heat in everyday life (Rahmi & Rosdiana, 2018). Softboned-milkfish or familiar with "Bandeng Presto" in Indonesian.

Bandeng presto is the name of a food product the manufactured derived from bandeng that is pressed using a presto pan. Bandeng is one of the mainstay fish types of pond farming in Sidoarjo which is relatively easy to maintain because it has adaptability properties in new places (Masyitoh, 2017). The people of Sidoarjo always serve bandeng presto as a special menu during a certain celebration (Hikmah et al., 2020). The people of Sidoarjo process the results of their ponds into various food products, one of which is Bandeng Presto (Sufa et al., 2020). This bandeng presto can be one of the local potentials of the people of Sidoarjo because it can supply additional income if the product is sold to the public. Processed food is the target of tourists or food lovers because of its delicious and savory taste (Sinaga et al., 2022). Bandeng presto is prepared in a presto pot or pressure cooker, which was designed by Denis Papin, a French physicist and mathematician who produces tools out of cast iron with lockable lips to raise the boiling point of water and temperature so that bones become tender and flesh cooks quickly (Rahmi & Rosdiana, 2018). Based on the background description above, this study aimed to improve students' learning outcomes by applying a comics problem-based learning model implementation comics-based PBL model on heat and its transmission.

RESEARCH METHOD

General Background

This study uses a quantitative approach with a type of pre-experimental design research and research design, namely a one-group pretest-posttest design. There is a paradigm in the use of this design with the pretest before treatment will make the data obtained more accurate because it can compare conditions before treatment (Sugiyono, 2016). The study sample is taken randomly, and all students in the selected class will be made into research samples. The data was collected using observation sheets for learning implementation, written test sheets, and response questionnaire sheets in this study. This study emphasizes the analysis of improved student learning outcomes before and after following the learning process with a comics based PBL model. The PBL model is student-centered in solving a problem collaboratively and the teacher acts as a facilitator. Student learning outcomes are considered to improve if there is a significant difference between the pretest and posttest and the probability value or significance level is less than 0.05 (Pallant, 2002); (2) The result of N-gain is in the high category which is at an interval of $0.70 \leq (<g>) \leq 1.00$ (Hake, 1999).

Participants

This study was conducted on learning science subjects on heat material and its transmission for two meetings. The study sample taken was thirty-two students with a

population of 288 students who were grade VII students at one of Public Junior High Schools in the Sidoarjo Regency, East Java, which was conducted in the Odd Semester of the 2021/2022 Academic Year. The study sample was taken randomly, and all students in the selected class would be the study sample.

Instrument and Procedures

Study instruments used in the collection of data on comics based PBL model implementation to improve students learning outcomes on heat and its transmission are learning implementation observation sheet instruments, written test sheets and response questionnaire sheets. This study used comics adapted from the study of Rahmi & Rosdiana (2018). The learning implementation observation sheet is used to analyze the implementation of learning during the learning trial in the classroom. The assessment criteria given on each aspect and the percentage criteria for implementation in managing learning are described in Table 1 and Table 2.

Table 1. Criteria for the implementation of the assessment of each aspect.

Score	Category
4	Very Good
3	Good
2	Somewhat Good
1	Less/Not Good

Table 2. Criteria for the percentage of implementation in managing learning.

Score (%)	Category
$80 < N \leq 100$	Very Good
$60 < N \leq 80$	Good
$40 < N \leq 60$	Somewhat Good
$20 < N \leq 40$	Less/Not Good
$0 < N \leq 20$	Very Less

(Sumitro et al., 2017)

The written test sheet is a pretest and posttest that uses multiple-choice questions to examine the improvement in student learning outcomes before and after theraphy. The response questionnaire sheet used is a closed questionnaire to find out the student's response after getting treatment. The student response questionnaire sheet uses the Likert scale method which requires respondents to show a level of approval to a series of statements (Suwandi et al., 2018). There are several answer criteria on the Likert scale that can be seen in Table 3.

Table 3. Criteria for answers to the Likert scale.

Category	Score
Strongly Agree	5
Agree	4
Somewhat Agree	3
Somewhat Disagree	2
Strongly Disagree	1

There are various steps to this study that must be completed. Pre-study is the first level. The researcher will plan study activities, conduct preliminary investigations, formulate questions, figure out assumptions and hypotheses, and choose study instruments and methodologies at this stage. The study's implementation is the second stage. We conduct study activities to get data at this stage. Evaluation is the third stage. The study generates a report based on the study data that has been processed and analyzed using the chosen instrument and draws conclusions from the study results at this stage. A flowchart of the study procedure is shown in Figure 1.

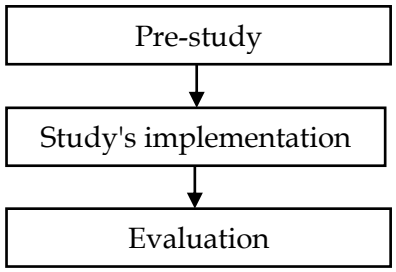

Figure 1. Flowchart of the study procedure.

Data Analysis

This study used the following data analysis techniques: (1) observation analysis of learning implementation; (2) analysis of student learning outcomes from written test results; and (3) analysis of student response questionnaires. Observation of learning implementation is used to analyze the implementation of learning during the learning trial in the classroom. The criteria for the implementation of learning are said to be good if every aspect of observation given by the observer is in the good or excellent category. Determination of the percentage of learning implementation assessment results can use Equation 1.

$$Percentage\ of\ learning\ implementation = \frac{\sum per - item\ acquisition\ score}{max\ score}\ x\ 100\% \quad (1)$$

The findings of the study of normalized gain scores can be used to evaluate improvements in student learning outcomes (N-gain). However, it was previously analyzed using a classic assumption test whose type is a normality test, and a paired *t-test*. Normality tests are designed to determine whether a study sample is from a normal distributed population or not, and to determine whether subsequent tests should use parametric or nonparametric statistics (Pradana et al., 2020). Utilizing the SPSS for Windows Version 16 application, this test was conducted using data from student pretest and posttest results. The normality in this study used Kolmogorov-Smirnov guidelines because the samples taken were more than 20 (n > 20) (Massey, 2017). In the normality test decision-making guidelines according to Kolmogorov-Smirnov that the level of significance (Sig.) used is 5% with a value of $\alpha > 0.05$ then the distribution is normal, otherwise if the value of $\alpha < 0.05$ then the distribution is not normal (Pallant, 2007).

A paired t-test is used to see if there is a substantial increase in the significance of the mean gain. If the probability value is less than 0.05, the difference between the pretest

and posttest is considered significant, and hypothesis testing is required (Pallant, 2002). The hypothesis contained in this study is symbolized by H_O and H_1. The hypothesis proposed is: (a) H_O: no significant difference exists between learning outcomes before and after learning; (b) H_1 : there is a difference in significance between learning outcomes before and after learning (Pallant, 2002). After obtaining the results of the paired t-test, Cohen's d test or effect size analysis was performed. Effect size is a secondary integrative analysis that involves using statistical processes on the outcomes of testing research hypotheses in order to identify the extent of the impact of applied learning (Agustin et al., 2021). This test was conducted using the Microsoft Excel 2010 program. The results of this test are obtained from the recapitulation of pretest and posttest data which are then calculated by comparing the average difference between pretest posttest and standard deviation (STDEV) pretest posttest. The findings of the effect size value can be evaluated using Table 4 according to Cohen (1988).

Table 4. Interpretation of Effect Size values

Effect Size	Interpretation
$0 < d < 0,2$	Small
$0,2 < d \leq 0,5$	Medium
$0,5 < d \leq 0,8$	Large
$d > 0,8$	Very Large

Additionally, the students' pretest and posttest results will be examined using N-gain from the outcomes of the normalized gain scores analysis. This test was conducted using the Microsoft Excel 2010 program by comparing the actual earn score and the maximum earned score that can be expressed in Equation 2.

$$< g > = \frac{\%\,(Sf) - \%(Si)}{\%\,(Smax) - \%(Si)} \quad (2)$$

Information:

$<g>$: *N-gain* score
S_i : Initial score (*pretest*)
S_f : Final score (*posttest*)
S_{max} : Max score

According to Hake (1999), from the results of *N-gain* calculations carried out there are three criteria that can be observed in Table 5. Once the percentage value per item is known, the results of the students' response questionnaire can be analyzed with criteria that can be seen in Table 6.

Table 5. *N-gain* criteria.

***N-gain* Range**	***N-gain* Criteria**
$(<g>) < 0,30$	Low
$0,30 \leq (<g>) \leq 0,70$	Medium
$0,70 \leq (<g>) \leq 1,00$	High

Student response questionnaire data is analyzed by calculating the per-item value for each category using Equation 3.

$$per - item\ percentage = \frac{per-item\ acquisition\ score}{\max\ score}\ x\ 100\% \quad (3)$$

Table 6. Criteria for the percentage of student response questionnaires.

Score Percentage	Category
0% < N ≤ 20%	Very Weak
20% < N ≤ 40%	Weak
40% < N ≤ 60%	Sufficient
60% < N ≤ 80%	Strong
80% < N ≤ 100%	Very Strong

RESULTS AND DISCUSSION

According to the findings of the study, the following are the findings: (1) Learning implementation data; (2) Student learning outcomes; and (3) Data on student response questionnaire results. All data obtained at the implementation stage will be analyzed descriptively quantitatively to find the quality of learning implementation with the comics-based PBL model, find out how the comics-based PBL model on heat and its transmission can increase student learning outcomes, figure out the level of approval scale of student responses to learning activities. The implementation of learning using the comics based PBL model on heat and its transmission is seen by assessing the implementation of learning by following the learning implementation plan when the teaching and learning process takes place in the classroom for two meetings. There is an average result of the percentage of learning performance obtained in the study can be seen in Table 7.

Table 7. Average learning implementation.

Meeting To	Average Percentage (%)	Category
1	94.12	Very good
2	93.38	Very good

Table 7 shows the average percentage of comics based PBL model learning results at the first meeting was 94.12 percent with good categories, while the average percentage at the second meeting was 93.38 percent with excellent categories. Student learning outcomes using the comics based PBL model on heat material and its transmission are taken from aspects of student knowledge. The findings of the study of normalized gain scores can be used to decide if student learning outcomes have improved (N-gain). However, it was previously analyzed using a classic assumption test whose type is a normality test and continued with paired t-test. Based on the data that has been approved can be described in Table 8.

Table 8. The results of the Kolmogorov-Smirnov normality test.

	Kolmogorov-Smirnov	
	Pretest	***Posttest***
N	32	32
Mean	36,56	80,00
Asymp. Sig. (2-tailed)	0,205	0,415

Table 8 shows the results of the normality test shows that the data are spread out in a regular way. This is analyzed from sig level results. Pretest and posttest show data of 0.205 and 0.415 which in decision making the value of Sig. obtained > 0.05 which means normal distribution (Pallant, 2007). A paired t-test is used to see if the significance of the mean gain has increased significantly. Based on the data that has been tested can be described in Table 9.

Table 9. Paired t-test results.

	Paired t-test		
	t	**df**	**Sig. (2 tailed)**
Pair 1 Pretest - Posttest	-35,070	31	0,000

Table 9 shows the results of the paired t-test show that the probability value or Sig. 0.000 where the value < 0.05. If the difference between the pretest and posttest is less than 0.05, it can be concluded that there is a significant difference, rejecting H_O and accepting H_1 (Pallant, 2002). This analysis showed that there was a significant difference or influence on the average values of pretests and posttests after applying the comics based PBL model to the heat and its transmission. The effect size test will show how much influence the comics based PBL model has had on learning. Based on the data that has been tested can be described in Table 10.

Table 10. Effect size test results.

Effect Size	
Mean difference pretest posttest	43.44
Standard Deviation (STDEV)	7.01
Cohen's d	6.20
Category	Very Large

The results of the effect size test, based on the data in Table 10, show that using the comics based PBL model on heat and its transmission to improve the learning outcomes of grade VII students has a very large effect on the learning process, with a score of 6.20, which is in the very large category. The improvement of learners' learning outcomes can be reviewed based on the results of the N-gain test analysis. The N-gain test can be done if the resulting data is normal distribution, so this research continues with the N-gain test, it has been shown in the earlier normality test analysis that the data obtained is the normal distribution. Based on the data that has been tested can be described in Table 11.

Table 11. Learning outcomes.

	Student Written Test Scores	
	Pretest	**Posttest**
N	32	32
Mean	36.56	80.00
Max	70	100
Min	10	50
Median	30	80
Mode	30	80
Standard Deviation	16.19	12.44
N-gain	0.72	
N-gain Percentage	71.53	
N-gain Category	High	

Based on the student's written test score data in Table 11, the mean N-gain test score is 0.72, and the proportion in the high category is 71.53. This proves that there is an increase in student learning outcomes after applying the comics based PBL model on heat and its transmission. Students' responses are based on the results of questionnaires given to students in grade VII with the goal was to find out how much students responded to PBL models based on comics about heat and its transmission. Below is a percentage chart of student response questionnaires per item.

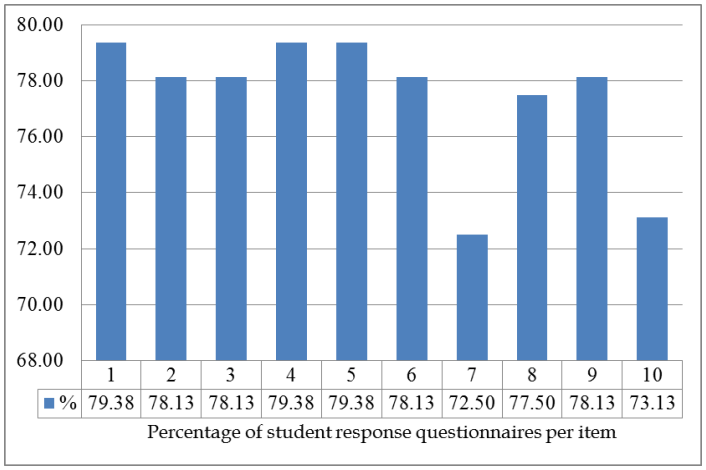

Figure 2. Diagram of the percentage of student response questionnaires per item.

The percentage result diagram in Figure 2 shows that students' responses to the use of the comics based PBL paradigm are "strong." This is by following the interpretation of the student response category in Table 6 because the percentage value of student response questionnaires per item is at intervals of 60% - 80% so it gets a strong category. The PBL model is a teaching method that uses the scientific method to teach students critical thinking and problem-solving skills through the use of real-world issues (Rahmadita et al., 2021). PBL is active learning where teachers act as facilitators and are student-centered (Neto et al., 2018). The PBL model can be applied using learning media because it can indirectly affect interest and motivation for students' learning spirit in participating in learning activities for a short time (Rahmadita et al., 2021). One

form of learning media used in this study is comics. Comics are usually in the form of sequentially illustrated stories to convey information to readers (Mutiaramses & Fitria, 2022). Comics are one of the suitable image media to be applied in the learning process (Rahmi & Rahmati, 2020). This can be explained because learning by seeing and reading illustrated stories makes it easier for students to understand and remember the information contained in the book (Sinta et al., 2021). Comics media is associated with the PBL model strategy will be able to make students more active in natural science learning which is invited to find real-world problem solving easily.

The N-Gain test was used to examine the improvement in learning outcomes. This research will continue with the N-gain test if the resulting data is distributed normally. The collected data has a normal distribution, as shown by the above analysis of the normality test. The average N-gain test result in this study was 0.72 with Hake (1999) interpretation falling into the high category. Data from N-gain shows that grade VII students learned more about heat and its transmission when they used the PBL model based on comics. This is by following study conducted by Aslam et al., (2021) that there is an influence of the impact of the PBL paradigm on vocational students' learning outcomes. Other study has also been conducted by Mutiaramses & Fitria (2022) proving that problem-oriented development based on digital comics learning can improve science literacy. The same study was conducted using comics to improve students' knowledge of disaster mitigation, yielding pretest data of 60.30 with sufficient categories, posttest data of 79.70 with good categories, and N-gain results of 0.42 with medium categories, demonstrating that it can improve students' knowledge of disaster mitigation (Noviana et al., 2019).

Students' responses are depending on the outcomes of questionnaires presented to pupils in grade VII with the goal was to find out how much students responded to PBL models based on comics about heat and its transmission. This response questionnaire is filled directly by students by checking each statement according to the students' opinion. The spread of this student response questionnaire was carried out after being given a posttest question. The student response questionnaire sheet used a Likert scale method that requires respondents to show their level of approval of a series of statements (Suwandi et al., 2018). Based on the findings of the student response questionnaire analysis after applying the comic-based PBL model on heat and its transmission is "strong" by following Riduwan (2009) interpretation if the percentage value is at an interval of 60% - 80% get a strong category. This shows that after implementing the comics based PBL model on heat and its transmission, student approval is high. This is by following study conducted by Mutiaramses & Fitria (2022) proves that problem-oriented development based on digital comics learning can improve science literacy. Other study is also carried out with the use of comics to improve students' knowledge of disaster mitigation, where the use of comics can attract learning and facilitate students in the learning process (Noviana et al., 2019).

CONCLUSION

This study's findings show that after applying the comics problem-based learning model implementation on heat and its transmission, the model is effective or have a huge effect in enhancing students learning outcomes on heat and its transmission. Proof is shown in the implementation of the average learning process carried out in the

category of very good and N-gain is in the high category as well as the student response questionnaire gets strong response. In conclusion, comics problem-based learning model implementation can be used as a reference in teaching and learning activities since it gets a good response from student activities and improve learning outcomes. Implication of this study is the implementation of a comics based PBL strategy, which is expected to improve student learning outcomes in natural science learning following curriculum needs. This study has flaws, such as the small amount of time spent using the PBL model in the learning process, even though the PBL model requires a significant amount of time in general. Based on the findings of this study and earlier study into the use of comics-based PBL models in enhancing student learning outcomes, it is hoped that future research would link ethnoscience or socio-scientific issues so that learning is more contextual and time is used effectively, motivating students to be more involved in their learning and therefore increasing learning outcomes.

REFERENCES

Agustin, S., Asrizal, A., & Festiyed, F. (2021). Analisis effect size pengaruh bahan ajar ipa bermuatan literasi sains terhadap hasil belajar siswa SMP/MTs. *Jurnal IPA & Pembelajaran IPA*, *5*(2), 125–137. https://doi.org/10.24815/jipi.v5i2.19606

Annisa, S.A., Lesmono, A.D., & Yushardi, Y. (2020). Comic-based module development andro-web to improve problem solving ability in physics in high school students. *Berkala Ilmiah Pendidikan Fisika*, *8*(1), 40–49. https://doi.org/10.20527/bipf.v8i1.7641

Aslam, L.K., Suparji, & Rijanto, T. (2021). The effect of problem based learning model on learning outcomes in the vocational high school students. *International Journal for Educational and Vocational Studies*, *3*(4), 264–267. https://doi.org/10.29103/ijevs.v3i4.3958

Aulia, J., Permana P, N. D., Zarkasih, Z., & Nova, T. L. (2020). Meta-analisis pengaruh penerapan pendekatan saintifik berbantuan komik terhadap hasil belajar IPA siswa SMP. *Journal of Natural Science and Integration*, *3*(1), 70–76. https://doi.org/10.24014/jnsi.v3i1.9617

Chang, M.C., Shaeffer, S., Al-Samarrai, S., Ragatz, A.B., de Ree, J., & Stevenson, R. (2014). Teacher reform in indonesia: The role of politics and evidence in policy making. *International Bank for Reconstruction and Development/The World Bank*. https://doi.org/10.1596/9780821398296

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (second edition). New York: Lawrence Erlbaum Associates.

Cowden, C.D., & Santiago, M.F. (2016). Interdisciplinary explorations: Promoting critical thinking via problem-based learning in an advanced biochemistry class. *Journal of Chemical Education*, *93*(3), 464–469. https://doi.org/10.1021/acs.jchemed.5b00378

Dewantara, D. (2020). The influence of educational comics on the concept of static electricity toward student's learning outcomes and communication skills. *Thabiea: Journal of Natural Science Teaching: Journal of Natural Science Teaching*, *3*(1), 20–30. https://doi.org/10.21043/thabiea.v3i1.6894

Fitria, J.N.R.I. (2022). Penerapan problem based learning (pbl) berbasis diskusi untuk

meningkatkan hasil belajar peserta didik SMK negeri alu kab polewali mandar sulawesi barat. *Jurnal Pemikiran dan Pengembangan Pembelajaran*, *4*(2), 203–212.

Hake, R.R. (1999). *Analyzing Change/Gain Scores*. Dept of Physics, Indiana University.

Haqiqi, K. (2018). Analisis faktor penyebab kesulitan belajar IPA siswa SMP kota semarang. *Jurnal Pendidikan Sains & Matematika*, *6*(1), 37–43. DOI: https://doi.org/10.23971/eds.v6i1.838

Hikmah, D.A., Musaddad S.A.A., Utomo, A.P., Rozzaq, M., & Rahmi, F.A. (2020). Local indigenous governance dalam meningkatkan economic growt di kabupaten sidoarjo. *Spirit Publik: Jurnal Administrasi Publik*, *15*(1), 1-11. https://doi.org/10.20961/sp.v15i1.37983

Imran A.F., Ngampo, M.Y.A., & Ardiansyah. (2022). Implementation of the problem-based learning model and its effect on accounting learning outcomes during the covid-19 pandemic. *Journal of Educational Sciences*, *6*(2), 275–285. https://doi.org/10.31258/jes.6.2.p.275-285

Kassymova, G., Akhmetova, A., Baibekova, M., Kalniyazova, A., Mazhinov, B., & Mussina, S. (2020). E-learning environments and problem-based learning. *International Journal of Advanced Science and Technology*, *29*(7s), 346–356.

Masyitoh, K. (2017). Lelang Bandeng tradisional di kabupaten sidoarjo tahun 1969 - 2006 avatara. *E-Journal Pendidikan Sejarah*, *5*(2), 260–272.

Mutiaramses, & Fitria, Y. (2022). Development of problem based learning (pbl) oriented digital comics to improve students' science literacy. *Journal of Research in Science Education*, *8*(2), 699-704. https://doi.org/10.29303/jppipa.v8i2.1349

Neto, F.M., de Freitas Lopes, E G., de Almeida, L.M.B., Carlos, D.G., & Alves, F.H. (2018). A computational tool for supporting problem-based learning in the teaching-learning process. *Creative Education*, *9*(11), 1654–1666. https://doi.org/10.4236/ce.2018.911120

Ningrum, E. (2016). Pengembangan sumber daya manusia bidang pendidikan. *Jurnal Geografi Gea*, *9*(1), 1-9. https://doi.org/10.17509/gea.v9i1.1681

Noviana, E., Kurniaman, O., Munjiatun, Nugraheti, S., & Nirmala, S.D. (2019). Why do primary school students need disaster mitigation knowledge? (study of the use of koase comics in primary schools). *International Journal of Scientific and Technology Research*, *8*(11), 216–221.

Pallant, J. (2002). *SPSS survival manual: A step by step guide to data analysis using IBM SPSS* (*7th edition)*. Oxfordshire: Routledge.

Pallant, J. (2007). *SPSS survival manual: A step by step guide to data analysis using SPSS for windows (3rd ed.)*. Riverwood: Ligare Book Printer.

Pradana, D. D. W., Budiyanto, M., & Susiyawati, E. (2020). Improving junior high school student's learning outcomes through interactive multimedia of blood circulation system. *Pensa: E-Jurnal Pendidikan Sains*, *8*(1).

Rahmadita, N., Mubarok, H., & Prahani, B.K. (2021). Profile of problem-based learning (pbl) model assisted by PhET to improve critical thinking skills of high school students in dynamic electrical materials. *Journal of Research in Science Education*, *7*(4), 617–624. https://doi.org/0.29303/jppipa.v7i4.799

Rahmi, D.A., & Rosdiana, L. (2018). Peningkatan hasil belajar dengan menggunakan media science story berbasis etnosains. *Pensa: E-Jurnal Pendidikan Sains*, *6*(2), 108-113.

Rahmi, I., & Rahmati. (2020). Application of comic media to improve learning outcomes and educational affective students on straight motion material in class VIII SMP negeri 1 darul imarah aceh besar. *Jurnal Phi: Jurnal Pendidikan Fisika Dan Fisika Terapan*, *1*(2), 27–36. http://dx.doi.org/10.22373/p-jpft.v1i2.7240

Riduwan. (2009). *Dasar-dasar statistika*. Bandung: Alfabeta.

Sari, I.P., & Rokhmani, L. (2019). The implementation of problem based learning to increase activity and learning outcomes of economics subject in senior high school students ita. *Classroom Action Research Journal*, *3*(2), 78–84. https://doi.org/10.17977/um013v3i32019p033

Siahaan, K.W.A., Manurung, H.M., & Siahaan, M.M. (2021). Android-based learning media development strategies during pandemic times to improve student science literature. *International Journal of Education and Humanities*, *1*(1), 34–40.

Simamora, D.F., & Manurung, H.M. (2021). The effect of problem-based learning model during pandemic on the thematic learning outcomes of students in elementary school. *Jurnal Basicedu: Research & Learning in Elementary Education*, *5*(5), 3073–3088. https://doi.org/10.31004/basicedu.v5i5.1242

Sinaga, G.C., Sembiring, A., Sargih, B.M., Saragih, E.T., Girsang, S., Purba, N.M., Sipayung, H.A.P., & Purba, N. (2022). Makanan khas sidoarjo yang lezat dan nikmat untuk dicoba. *Gacashop.* https://gacasshop.com/makanan-khas-sidoarjo/

Sinta, I.N., Wandani, S., & Kurniawan, C. (2021). The influence of comic media on students' concept understanding on chemical bonding materials. *International Journal of Active Learning*, *6*(2), 85–90.

Sufa, S.A., Subiakto, H., Octavianti, M., & Kusuma, E.A. (2020). Wisata gastronomi sebagai daya tarik pengembangan potensi daerah kabupaten sidoarjo. *Mediakom : Jurnal Ilmu Komunikasi*, *4*(1), 75–86. https://doi.org/10.35760/mkm.2020.v4i1.2497

Sugiyono. (2016). *Metode penelitian pendidikan : Pendekatan kuantitatif, kualitatif dan R&D (23rd ed.)*. Bandung: Alfabeta.

Sujana, I.G. (2020). Meningkatkan hasil belajar IPA Melalui penerapan metode inkuiri terbimbing. *Journal of Education Action Research*, *4*(4), 514. https://doi.org/10.23887/jear.v4i4.28651

Sumitro, A.H., Setyosari, P., & Sumarmi. (2017). Penerapan model problem based learning meningkatkan motivasi dan hasil belajar IPS. *Jurnal Pendidikan: Teori, Penelitian, Dan Pengembangan*, *2*(9), 1188–1195.

Suwandi, E., Imansyah, F.H., & Dasril, H. (2018). Analisis tingkat kepuasan menggunakan skala likert pada layanan speedy yang bermigrasi ke indihome. *Jurnal Teknik Elektro*, *2*(9), 1188-1195.

Syofni. (2019). Implementation of problem based learning model to improve students' learning outcome of logic and set of FKIP mathematics education study program, university of riau. *Proceedings of the SS9 & 3rd URICES*, 978–979.

Wandani, R.W., Sopandi, W., Sujana, A., & Rosmiati, I. (2022). The effectiveness of the RADEC learning model assisted by digital comics media on students learning outcomes and interest in learning. *Proceeding The 4th International Conference on Elementary Education*, *4*(1), 721–729.

Yunarti, N. (2021). Analisa kesulitan dalam pembelajaran IPA pada siswa SMP negeri 1 Rambang. *Jurnal Education*, *7*(4), 1745–1749. https://doi.org/10.31949/education.v7i4.1570

Zamjani, I.P. (2020). *Faktor-faktor determinan hasil belajar siswa*. Jakarta: Pusat Penelitian Kebijakan.

*__Intan Dwi Safitri (Corresponding Author)__
Jurusan IPA, Fakultas Matematika dan Ilmu Pengetahuan Alam,
Universitas Negeri Surabaya,
Jl. Ketintang, Kec. Gayungan, Kota SBY, Jawa Timur 60231, Indonesia
Email: intan.18076@mhs.unesa.ac.id

Beni Setiawan, M.Pd., Ph.D.
Jurusan IPA, Fakultas Matematika dan Ilmu Pengetahuan Alam,
Universitas Negeri Surabaya,
Jl. Ketintang, Kec. Gayungan, Kota SBY, Jawa Timur 60231, Indonesia
Email: benisetiawan@unesa.ac.id

Muhamad Arif Mahdiannur, S.Pd., M.Pd.
Jurusan IPA, Fakultas Matematika dan Ilmu Pengetahuan Alam,
Universitas Negeri Surabaya,
Jl. Ketintang, Kec. Gayungan, Kota SBY, Jawa Timur 60231, Indonesia
Email: muhamadmahdiannur@unesa.ac.id