



Improving Students' Scientific Literacy Skills Using Inquiry-Based E-Comic At The Tenth Grader In Lampung Province

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ABSTRACT

This study aims to determine the effect of inquiry-based e-comic media on students' scientific literacy abilities and to determine students' responses to inquiry-based e-comic. This type of research is a quasi experiment; The sample in the study was taken using the cluster random sampling technique; The research data was taken through the pretest and posttest to see the increase in scientific literacy skills after the learning process while the use of a questionnaire in the experimental class was used to find out students' responses to e-comic media; The results showed that there was a significant effect of the use of inquiry-based e-comic media on students' scientific literacy skills with a significance value of the independent sample t-test of 0.000 or less than 0.05; The results of the questionnaire on student responses to inquiry-based e-comic media obtained an average percentage of 86% in the very good category

Peningkatkan Keterampilan Literasi Sains Menggunakan E-Comic Berbasis Inquiry Pada Siswa Kelas Sepuluh di Provinsi Lampung

ABSTRAK: Penelitian ini bertujuan untuk mengetahui pengaruh media e-comic berbasis inquiry terhadap kemampuan literasi sains peserta didik serta mengetahui tanggapan peserta didik terhadap e-comic berbasis inquiry. Jenis penelitian ini adalah quasi eksperimen; Sampel dalam penelitian diambil menggunakan teknik Cluster random sampling; Data penelitian diambil melalui pretest dan posttest untuk melihat peningkatan kemampuan literasi sains setelah proses pembelajaran sedangkan penggunaan angket di kelas eksperimen digunakan untuk mengetahui tanggapan peserta didik terhadap media e-comic; Hasil penelitian menunjukkan terdapat pengaruh yang signifikan penggunaan media e-comic berbasis inquiry terhadap kemampuan literasi sains peserta didik dengan nilai signifikansi uji independent sample t-test 0,000 atau kurang dari 0,05; Hasil angket tanggapan peserta didik terhadap media e-comic berbasis inquiry diperoleh rata-rata persentase 86% dengan kategori sangat baik.

INTRODUCTION

Scientific literacy skills in the 21st century are important for students to master in the current era of global competition. Students are required to have scientific literacy capabilities which include scientific knowledge, scientific process skills and scientific attitudes (Fakhriyah et al., 2017). Scientific literacy is a person's ability or skill to understand, communicate and apply scientific knowledge to solve problems so that they have a high attitude and sensitivity towards themselves and the environment in making decisions based on scientific considerations (Enawaty & Erlina, 2021). Scientific literacy skills are very important and fundamental for preparing students who are reliable, have good scientific competence and able to adapt in various situations (Aisyah et al., 2021). The current rapid development of science requires that students must be trained to seek and find a concept in the learning process (Mellyzar et al., 2022).

Based on the results Program for International Student Assessment (PISA) study of the 2018, Indonesia is ranked 71 out of 79 countries with a score of 396 out of an average PISA score of 489 (OECD, 2019). Meanwhile, based on TIMSS (Trends International Mathematics and Science Study) results in 2015, Indonesia is also at the lowest level (Low International Benchmark) and is ranked 4th lowest with a score of 397 (Nizam, 2016), this illustrates that students' scientific literacy abilities in the learning process in Indonesia are very low when compared to other countries. The low ability of students' scientific literacy should be used as an evaluation in the learning process to design learning that is more effective and efficient, so that learning objectives can be achieved optimally. The Program for International Student Assessment (PISA) in 2025 will also focus on science and learning in the digital world (OECD, 2021). In this case, the development and progress of technology can be utilized by educators to adjust the media used in the

learning process (Tamami et al., 2022), so that students' scientific literacy abilities can increase.

Technological advances in digital era, make educators who are directly involved in the learning process must adapt to designing media using digital systems (Rahayuningsih & Muhtar, 2022). This challenge is the responsibility of educators to have readiness in accessing and mastering technology in accordance with the times. The use of media in learning can help students to receive and understand subject matter optimally (Halawa et al., 2022). Along with the times, innovation in the media plays an important role in supporting the process of learning activities, where the learning process is not only obtained from educators, but learning activities can be carried out independently by students (Maharani & Fernandes, 2022).

Learning with digital media can facilitate students to learn more broadly, anytime and anywhere via computers or cellphones without being limited by distance, space and time (Fatira et al., 2021). Comics are a learning medium that functions to convey learning messages (Damayanti & Supriyatin, 2022). Comics contain a series of stories that are presented through pictures and writing so that messages in comics are more easily understood by readers (Salamuddin & Fadilah, 2022). Rohmanurmeta & Dewi (2020) argue, with digital comic, educators can introduce technology to students and can easily understand the material conveyed through stories.

Digital comic media can be accessed easily by students (Udayani et al., 2021). This media can be shared by educators through various social media so students can access digital comics anywhere via laptops and handphone as long as these media are available on these electronic devices (Aprillia et al., 2022). E-comics or digital comics can be used as an alternative to convey information in the learning process, so that learning becomes more meaningful and can help students solve problems encountered in the

learning process so that students' scientific literacy skills increase.

Advancement of technology in digital era, make educators who are directly involved in the learning process must adapt to designing media using digital systems (Sudarmo et al., 2021). Agree with Yolida et al. (2022), this challenge is the responsibility of educators to have readiness in accessing and mastering technology in accordance with the times. This is as much as possible Audriansyah et al. (2022) in his research The use of media in learning can help students to receive and understand subject matter optimally. Along with the times, innovation in the media plays an important role in supporting the process of learning activities, where the learning process is not only obtained from educators, but learning activities can be carried out independently by students.

Learning with digital media can facilitate students to learn more broadly, anytime and anywhere via computers or cellphones without being limited by distance, space and time (Ritonga et al., 2022). Comics are a learning medium that functions to convey learning messages (Reis et al., 2022). Comics contain a series of stories that are presented through pictures and writing so that messages in comics are more easily understood by readers (Senen et al., 2021). With digital comic, educators can introduce technology to students and can easily understand the material conveyed through stories (Saputra & Pasha, 2021).

Digital comic media can be accessed easily by students (Rina et al., 2020). This media can be shared by educators through various social media so students can access digital comics anywhere via laptops and handphone as long as these media are available on these electronic devices (Chairunnisa et al., 2020). E-comics or digital comics can be used as an alternative to convey information in the learning process, so that learning becomes more meaningful and can help students solve problems encountered in the learning process so that

students' scientific literacy skills increase. Putranta et al., (2020) also explained that the level of scientific literacy ability of students is very dependent on the ability of each student to use the concepts they already have to solve problems that occur in everyday life appropriately, effectively and efficiently by using media assistance in learning.

The use of comic media can turn abstract concepts into concrete by connecting them with examples in everyday life through images, symbols and aided by dialogue which is closely related to everyday events. Likewise with ecosystem material which is closely related to everyday life, comic media will make it easier for students to understand this material so that students can absorb and apply this theory in real life (Lestari et al., 2021). This is supported by the opinion of Dewi (2022), which states that student-centered learning can train their ability to observe natural science phenomena so that they can train their ability to find out and observe related material presented.

Research on digital comic media has been carried out by previous researchers, including the influence of the problem-based learning model assisted by digital comics on the scientific literacy abilities of Grade VII junior high school students in environmental pollution material (Susanto et al., 2022), the use of multimedia learning to increase literacy science of class VIII junior high school students on motion in living things (Budiarti & Tanta, 2021).

This research shows that the use of digital comic media in learning has not been integrated with learning models emphasizing the process of searching for and finding answers independently by students. In fact, digital comics can be used as a medium that can help students to provide explanations about the phenomena contained in comics, use scientific evidence and be able to understand the problems contained in comics. The research results of Mutasam et al., (2021) show that increasing student scientific literacy is also supported by integration of learning tools. Therefore, the

researcher is interested For conducted research on the effect of inquiry-based e-comic media on the scientific literacy skills of class X students on the subject matter of ecosystems.

METHOD

This research was conducted in the even semester of the 2021/2022 school year in tenth grader. The sample was determined using a simple random sampling technique with a quasi-experimental design. The procedure in this study was carried out in three stages, the preparatory stage began with carrying out observations, determining research samples, compiling learning tools (lesson plan, learning media, worksheets, pretest-posttest sheets and assessment rubrics) and preparing research instruments.

At the implementation stage it begins with giving a pretest in the experimental and control classes, carrying out the learning process using inquiry-based e-comic media in the experimental class and giving a posttest in the experimental and control classes after carrying out the learning process. While the data processing stage begins with examining the research data, this check is carried out to determine the completeness of the data that has been collected in the study. After checking, the data obtained is then classified based on its type to be analyzed, the results of the analysis of the data obtained are then concluded.

Quantitative data from this study were obtained by giving tests before and after the learning process took place (pretest-posttest), the pretest and posttest results obtained were then calculated using the normalized-gain (n-gain) test. The normality of the data in this study was carried out using the SPSS program using the Kolmogorov-Smirnov test, The homogeneity test is calculated using guidelines for decision making based on the significance value of Levene's test of equality of error variance, while the hypothesis test is calculated through an independent sample t-test, this is because the samples used are not paired. In addition to quantitative data, qualitative data in this study was carried out by distributing interest questionnaires to class students in the experimental class on e-comic media.

RESULTS AND DISCUSSION

This research was conducted to describe the effect of inquiry - based e-comic learning media on scientific literacy skills and to find out students' responses to inquiry - based e-comic learning media in tenth grade of senior high school on the subject matter of ecosystems. The research data that has been carried out are as follows.

a. Increasing students' scientific literacy skills on the subject matter of ecosystems

Table 1. Results of normality, homogeneity and hypothesis tests through SPSS 25

	Kolmogorov-Smirnov ^a Sig.	Levene's Test for Equality of Variances Sig.	T-test for equality of means Sig. (2-tailed)
Experiment	,200*	0,071	0,000
Control	,074		

Based on the table above, after testing using SPSS 25 it can be seen that the normality test using the Kolmogorov Smirnov test obtained a significance result greater than 0.05 (> 0.05), this indicates that the data is normally distributed. While the homogeneity test was carried out using the

Levene test by looking at the significance of Levene's test for equality of variances , based on the results of the tests that have been carried out, a significance value of 0.071 or more than 0.05 is obtained, this indicates that the data group has a normal or homogeneous distribution. Furthermore, hypothesis

testing was carried out using an independent sample t-test by looking at the significance value (2- tailed). Based on the tests that have been carried out, a significance value of 0.000

or less than 0.05 is obtained, so the test decision is to reject H₀ or accept H₁.

Improving the scientific literacy skills of tenth grade is carried out using the n-gain test. The n-gain test results are as follows.

Table 2. Calculation of the n-gain test results in the experimental and control classes

N-gain Score	Class	Average		N-Gain	Interpretation	
		Pretest	Posttest			
	Experiment	Pretest	46,10	0,55	0,3 < N-gain > 0,7	Moderate
		Posttest	75,90			
	Control	Pretest	39,35	0,29	N-gain ≤ 0,3	Low
		Posttest	57,83			

Based on the table above, after calculating the n-gain score by subtracting the posttest and pretest score, then the maximum score (100) minus pretest score. The n-gain score obtained in the experimental class got a higher score compared to the control class with moderate

interpretation. In addition, the questions used in the pretest and posttest are also based on indicators of scientific literacy, namely aspects of competence, while the results of the average score of students can be seen in the table below.

Table 3. The n-gain score on the scientific literacy indicator in the competency aspect of the experimental class

Scientific Literacy Indicator	First Meeting			Second Meeting		
	Pretest	Posttest	N-Gain	Pretest	Posttest	N-Gain
Indicator 1. Provide an explanations of Scientific Phenomena	52,6	76,3	0,50	57,8	84,1	0,62
Indicator 2. Use of Scientific evidence	42,1	73	0,53	38,5	71,8	0,54
Indicator 3. Ability to identify issues related science	42,1	77,6	0,61	53,6	74,7	0,45

Based on the table above, it can be seen that for the first meeting the ability of students to identify issues related to science got the highest n-gain score. While at the second meeting, the first indicator got the highest score. In this case, the ability of students to

provide explanations about scientific phenomena gets a higher score compared to the other two indicators.

b. Student responses to inquiry-based e - comic media

Table 4. The results of the student response questionnaire

No	Questionair Indicator	Questionair items	Average	Category
1	Enthusiasm of students and curiosity in participating in learning	1, 3, 5, 6, 8, 14	91,6%	Very good
2	Student responses in participating in learning activities	2, 7, 9, 10, 12, 18	89,4%	Very good

No	Questionnaire Indicator	Questionnaire items	Average	Category
3	Concentration and accuracy of students in participating in learning activities	4, 11, 15, 17	79%	Good
4	Willingness and hard work of students in participating in learning activities	13, 16, 19, 20	85,3%	Very good
	Average		86%	Very Good

Based on the results of the student response questionnaire in the table above, the percentage of the first indicator gets the highest average in the very good category, this shows that the enthusiasm and curiosity of students increases by using inquiry-based e-comic media. Whereas indicators of concentration and accuracy of students in participating in learning activities get a lower percentage compared to other indicators.

Inquiry-based e-comic learning media has an effect on students' scientific literacy abilities on the subject matter of ecosystems. This can be seen from the calculation of the n-gain score in the experimental class in table 2. The increase in students' scientific literacy skills in the competency aspect in the experimental class was caused by the use of inquiry - based e-comic media . Students are able to understand, apply and combine the knowledge they already have. This can be seen when students are given the opportunity to read and understand e-comic media, students are able to combine the knowledge they already have with the concepts found in e-comics (Mellyzar et al., 2022). In line with Sanory (2019) which revealed that inquiry learning in cooperative groups allows students to learn to find out from something that is not yet known, in an effort to find out students are more open so that students can express ideas or opinions according to their own thoughts or initiatives so that students can demonstrate the diversity of their critical thinking.

In the learning process, after the e-comic media is distributed, students are given the opportunity to read and understand the e-comic for about 10

minutes, students are also asked to formulate problems according to the concepts that have been found in the e-comic . Students who have made a problem statement, are then guided to make a hypothesis and look for literature from books or websites to strengthen the hypotheses that have been made. After obtaining literature, students are asked to process and present data as material for consideration in solving problems. At the same time, students were also asked to compare some of the concepts found in the e-comics with things around their homes when filling out worksheets.

On the worksheet, students are asked to compare the abiotic and biotic components that make up the ecosystem in the e-comic with the components around their homes. Besides being able to distinguish between abiotic and biotic components, students are also able to categorize these components. Students can compare the biotic components in e-comics and around their homes. It was explained that the biotic components in the e-comic consist of fish, frogs, microbes, worms, decomposing bacteria and fungi. While around the house, students also explained that there is the same ecosystem, namely a pond ecosystem with biotic components such as fish, frogs, microbes, and worms, but lizards, snakes, kale and grass are often found. This response proves that students can provide an explanation of what biotic components are around their homes.

The increase in scientific literacy skills in the competency aspects of students can be seen from the n-gain score of the scientific literacy indicator (table 3). Based

on the data that has been obtained, at the first meeting students' ability to identify issues related to science gets the highest n-gain score. Based on the responses given by students, it shows that students can determine and differentiate abiotic and biotic components based on the discourse that has been provided. This proves that students can analyze the discourse that has been given so that they can correctly distinguish between abiotic and biotic components. In line with research conducted by Fadlika et al., (2020), the percentage of students who answered correctly for indicators identifying issues related to science got the highest percentage, namely 76.92% in the high category. Fananta et al., (2019) in his research revealed that students who read inquiry-based science comics can help students develop their abilities in making diagrams, data charts, and draw conclusions honed gradually. Students are involved in situational thinking processes using comics with inquiry sequences such as asking scientifically oriented questions, using evidence-based input, formulating alternative explanations based on evidence and connecting them with scientific knowledge.

At the second meeting, students' ability to provide explanations about scientific phenomena received a higher n-gain score compared to the other two indicators. In this study, students have the ability to analyze statements regarding interactions between ecosystem components based on the knowledge they already have, so that students can provide explanations that are in accordance with the discourse that has been given. In line with the results of research that has been conducted by Ihsan & Jannah (2021) showing the same results, the highest score is obtained by the indicator providing an explanation of scientific phenomena. This is because students practice a lot and understand material with natural phenomena and events in everyday life. The 2018 PISA results also show that in scientific literacy, students in Indonesia get an average score of 78%. In this case students

can recognize correct explanations for familiar scientific phenomena and can use that knowledge to identify, in simple cases (OECD, 2019).

The storyline presented in e-comics makes it easier for students to understand the material presented (Fadilah, 2021). This is because in e-comic contains pictures, so that it attracts the attention of students in the learning process. In line with the results of research conducted by Narestuti et al., (2021) which stated that e-comic learning media is able to make students creative, varied and innovative and able to make students feel happy learning science, especially biology material. With the existence of e-comic media, learning in class is able to create a fun atmosphere, but still serious so students don't feel bored and sleepy during the learning process. In addition, the intensity of student involvement in participating in learning activities can also increase because the presentation of this e-comic can trigger the involvement of their imagination (Khotimah & Hidayat, 2022). Listianingsih et al., (2021) also revealed that comic content that displays material in the form of stories made in simple language and applied in everyday life makes it easier for students to understand the material.

Inquiry based e-comic media in the learning process provides new experiences for students because they have never been used before, this is also expressed directly by students during the learning process in class, this new experience felt by students influences student motivation in following learning activities in class. The inquiry model is often referred to as the investigative model, because it provides an opportunity for students to explore knowledge through in-depth exploration of a problem and then seek answers (Adnan et al., 2021). This is also supported by the results of research conducted by Afriana & Prastowo, (2022) that the use of e-comic media can foster student learning motivation and enthusiasm, because the presentation of e-comics is

illustrated and has a storyline in it so that students motivated to read it. Filjinan et al., (2022) through their research results revealed that learning using interactive e-comics is able to make students very enthusiastic in discussions, filling in the blanks in comics and in question and answer sessions and the class atmosphere becomes more enjoyable. In addition, Yulianti et al., (2016) explained that science comics can be understood because they are adapted to the level of children's intellectual development.

Student interest in the learning process is also evident in the results of student worksheets. In the experimental class, the worksheet results showed that students described examples of food chains and webs, this was different from the worksheet results in the control class. The interest of students in the experimental class towards e-comic media can also be seen from the results of the questionnaire on students' responses to e-comic media (table 4). Based on the 20 questionnaire items that have been distributed to students, it shows that students' enthusiasm, curiosity and students' responses in participating in learning activities get the highest percentage.

Based on these data, the use of e-comic media makes students more active in responding in the learning process. This is caused by students' curiosity about the material and storylines presented in e-comics. While the concentration and accuracy of students in participating in learning activities get the lowest percentage. It can be seen in the worksheet, where some students have not been able to provide complete conclusions. In line with research conducted by Ramadhani et al., (2021), students were less focused when answering questions, less thorough and also in a hurry when answering questions, so they could not complete the answers properly.

CONCLUSIONS AND SUGGESTIONS

Based on the research that has been done, the use of inquiry - based e-comic media has a significant effect on the scientific

literacy abilities for tenth grade of senior high school students on the subject matter of ecosystems, this is evidenced by the significance value of the Independent sample t-test, namely 0.000 or less than 0.05, so the test decision is to reject H_0 or accept H_1 . The increase in scientific literacy skills in the experimental class is evidenced by the results of calculating the n-gain score of 0.55 and is in the moderate category. This research still has drawbacks, including the aspects of scientific literacy observed in this study, only limited aspects of competence, besides that for other researchers who want to conduct research using inquiry - based e-comic media, they can add pictures and other features that are more interesting in comic. The use of this media must also pay attention to the learning time in the classroom, so that the material can be delivered in its entirety and does not take other lesson hours.

REFERENCES

- Adnan, G., Zulfikar, T., Armia, M. S., Gade, S., & Walidin, W. (2021). Impacts of inquiry learning model on students' cognitive and critical thinking ability. *Cypriot Journal of Educational Sciences*, 16(3), 1290-1299.
<https://doi.org/10.18844/CJES.V16I3.5851>
- Afriana, S., & Prastowo, A. (2022). Penggunaan Media Pembelajaran E-Comic dalam Menumbuhkan Motivasi dan Antusiasme Belajar Peserta Didik Sekolah Dasar. *Didaktis: Jurnal Pendidikan Dan Ilmu Pengetahuan*, 22(1), 41.
<https://doi.org/10.30651/didaktis.v22i1.11089>
- Aisyah, S., El Widdah, M., & Sukarno, S. (2021). Analysis of Science Literacy Ability and Teachers' Capability in Implementation of Learning by Science Literacy Oriented in Islamic Kindergarten at Bangko City. *Jurnal Penelitian Pendidikan IPA*, 7(SpecialIssue), 77-83.
<https://doi.org/10.29303/jppipa.v7isp>

ecialissue.1125

- Aprillia, Dewi, R. S., & Setiawan, S. (2022). Digital Comic Media: Pancasila Relationships in Daily Life. *MIMBAR PGSD Undiksha*, 10(2), 183–189. <https://doi.org/10.23887/jjpgsd.v10i2.41811>
- Audriansyah, L. U., Lesmanawati, I. R., & Nada, S. (2022). Developing The Cirebon City Toponymy-Based Digital Encyclopedia as a Plantae Learning Resource for the Tenth-Grade Senior High School Students. *Biosfer: Jurnal Tadris Biologi*, 13(1), 57–66. <https://doi.org/10.24042/biosfer.v13i1.12402>
- Budiarti, I. S., & Tanta, T. (2021). Analysis On Students' Scientific Literacy of Newton's Law and Motion System in Living Things. *Jurnal Pendidikan Sains Indonesia*, 9(1), 36–51. <https://doi.org/10.24815/jpsi.v9i1.18470>
- Chairunnisa, F., Maryuningsih, Y., Maknun, D., Audriansyah, L. (2020). The Application of Excretion System E-Module to Improve Science Literacy Skills. *Biosfer: Jurnal Tadris Biologi*, 13(1), 57–66. <https://doi.org/10.24042/biosfer.v13i2.13381>
- Damayanti, F., & Supriyatin, T. (2022). Implementasi Educational Comic Berbasis Aplikasi Comic Life sebagai Media Pembelajaran Alternatif. *Jurnal ABDINUS : Jurnal Pengabdian Nusantara*, 6(2), 365–373. <https://doi.org/10.29407/ja.v6i2.16551>
- Dewi, S. K. T. (2022). Pengaruh Media Pembelajaran E-Comic Berbasis Inquiry Terhadap Kemampuan Literasi Sains Peserta Didik Kelas X Sma N 2 Menggala Pada Materi Pokok Ekosistem. *Skripsi*. Lampung : Universitas Lampung.
- Enawaty, E., & Erlina, E. (2021). Analysis of Science Literacy Skills of Chemistry Education Students in Acid-Base Topics. *Jurnal Pendidikan Dan Pembelajaran Kimia*, 10(1), 8–15. <https://doi.org/10.23960/jppk.v10.i1.2021.02>
- Fadilah, H. D. (2021). Development of E-Comic Teaching Materials for Social Studies Learning in Elementary Schools. *Profesi Pendidikan Dasar*, 8(2), 109–120. <https://doi.org/10.23917/ppd.v8i2.15202>
- Fadlika, R. H., Mulyani, R., & Dewi, T. N. S. (2020). Profil Kemampuan Literasi Sains Berdasarkan Gender di Kelas X. *Quagga: Jurnal Pendidikan Dan Biologi*, 12(2), 104. <https://doi.org/10.25134/quagga.v12i2.2326>
- Fakhriyah, F., Masfuah, S., Roysa, M., Rusilowati, A., & Rahayu, E. S. (2017). Student's science literacy in the aspect of content science? *Jurnal Pendidikan IPA Indonesia*, 6(1), 81–87. <https://doi.org/10.15294/jpii.v6i1.7245>
- Fananta, M. R., Umbara, T., & Valdez, N. P. (2019). The Effect of Inquiry-Based Science Comics on Primary Learners' Scientific Literacy Skills. *GATR Global Journal of Business Social Sciences Review*, 7(4), 210–216. [https://doi.org/10.35609/gjbssr.2019.7.4\(1\)](https://doi.org/10.35609/gjbssr.2019.7.4(1))
- Fatira, F., Ferawati, F., Darmayani, D., Nendissa, Nendissa Arifudin, A., Anggaraeni, A., & Hidana, H. (2021). *Pembelajaran Digital*. Jawa Barat : Widina Bhakti Persada.
- Filjinan, S. K., Supeno, & Rusdianto. (2022). Pengembangan E-Komik Interaktif untuk Meningkatkan Literasi Sains Siswa SMP Pada Pembelajaran IPA. *Jurnal Pendidikan Berkarakter*, 5(2), 125–129. <http://journal.ummat.ac.id/index.php/pendekar>

- Halawa, A. A., Yulita, I., & Adriani, N. (2022). The development of Acid-Base Electronic Chemistry Comic Learning Media for High School Students. *Journal of Science Education Research*, 6(1), 24–30. <https://doi.org/10.21831/jser.v6i1.44997>
- Ihsan, M. S., & Jannah, S. W. (2021). Analisis Kemampuan Literasi Sains Peserta Didik Dalam Pembelajaran Kimia Menggunakan Multimedia Interaktif Berbasis Blended Learning. *EduMatSains: Jurnal Pendidikan, Matematika Dan Sains*, 6(1), 197–206. <https://doi.org/10.33541/edumatsains.v6i1.2934>
- Khotimah, H., & Hidayat, N. (2022). Interactive Digital Comic Teaching Materials to Increase Student Engagement and Learning Outcomes. *International Journal of Elementary Education*, 6(2), 245–258. <https://dx.doi.org/10.23887/ijee.v6i2>
- Lestari, R., Haryono, T., & Erman, E. (2021). Using Comic-Based Socio-Scientific Issues in inquiry learning to increase interest and achievement in science learning. *Thabiea: Journal of Natural Science Teaching*, 4(1), 62. <https://doi.org/10.21043/thabiea.v4i1.9919>
- Listianingsih, M., Astuti, I. A. D., Dasmo, D., & Bhakti, Y. B. (2021). Android-Based Comics: An Alternative Media to Improve Scientific Literacy. *Jurnal Penelitian Dan Pembelajaran IPA*, 7(1), 105. <https://doi.org/10.30870/jppi.v7i1.8636>
- Maharani, N. A., & Fernandes, R. (2022). Urgensi Media E-Comic dalam Pembelajaran Sosiologi di SMA. *Jurnal Sikola: Jurnal Kajian Pendidikan Dan Pembelajaran*, 4(1), 47–54. <https://doi.org/10.24036/sikola.v4i1.198>
- Mellyzar, M., Alvina, S., Zahara, S. R., Masrina, M., & Afrianti, S. (2022). Influence of POGIL and MFI Models on Science Literacy and Science Process Skills for Junior High School. *Jurnal Penelitian Pendidikan IPA*, 8(4), 2201–2209. <https://doi.org/10.29303/jppipa.v8i4.2121>
- Mutasam, U., Ibrohim, I., & Susilo, H. (2021). Penerapan Pembelajaran Sains Berbasis Inquiry Based Learning Terintegrasi Nature of Science Terhadap Literasi Sains. *Jurnal Pendidikan: Teori, Penelitian, Dan Pengembangan*, 5(10), 1467. <https://doi.org/10.17977/jptpp.v5i10.14131>
- Narestuti, A. S., Sudiarti, D., & Nurjanah, U. (2021). Penerapan Media Pembelajaran Komik Digital untuk Meningkatkan Hasil Belajar Siswa. *Bioedusiana: Jurnal Pendidikan Biologi*, 6(2), 305–317. <https://doi.org/10.37058/bioed.v6i2.3756>
- Nizam. (2016). *Ringkasan Hasil-hasil Asesmen Belajar Dari Hasil UN, PISA, TIMSS, INAP*. Pusat Penilaian Pendidikan Badan Penelitian dan Pengembangan Kementerian dan Kebudayaan: Jakarta.
- OECD. (2019). *Programme for International Student Assessment (PISA) results from PISA 2018*. Paris : OECD Publishing.
- OECD. (2021). *Summary of Tasks and Project Timeline Learning in The Digital Word Assessment*. Paris : OECD Publishing.
- Putranta, H., Setiyatna, H., Supahar, S., & Rukiyati, R. (2020). The Effect of Smartphones Usability on High School Students' Science Literacy Ability in Physics Learning. *European Journal of Educational Research*, 10(3), 1383–1396.
- Rahayuningsih, Y. S., & Muhtar, T. (2022). Pedagogik Digital Sebagai Upaya untuk Meningkatkan Kompetensi Guru Abad 21. *Jurnal Basicedu*, 6(4), 6960–6966. <https://doi.org/10.31004/basicedu.v6i4.3433>

- Ramadhani, R., Juandi, D., & Nurlaelah, E. (2021). A Meta-Analysis on The Effect of Inquiry Learning Model on Students' Mathematical Problem-Solving Skills. *Indonesian Journal of Science and Mathematics Education*, 4(3), 302–312. <https://doi.org/10.24042/ij sme.v4i3.9730>
- Reis, F., Palermo, T. M., Acalantis, L., Nogueira, L. C., Meziat-Filho, N., Louw, A., & Ickmans, K. (2022). "A journey to learn about pain": the development and validation of a comic book about pain neuroscience education for children. *Brazilian Journal of Physical Therapy*, 26(1). <https://doi.org/10.1016/j.bjpt.2021.04.009>
- Rina, N., Suminar, J. R., Damayani, N. A., & Hafiar, H. (2020). Character education based on digital comic media. *International Journal of Interactive Mobile Technologies*, 14(3), 107–127. <https://doi.org/10.3991/ijim.v14i03.12111>
- Ritonga, M., Febriani, S. R., Kustati, M., Khaef, E., Ritonga, A. W., & Yasmar, R. (2022). Duolingo: An Arabic Speaking Skills' Learning Platform for Andragogy Education. *Education Research International*, 2022. <https://doi.org/10.1155/2022/7090752>
- Rohmanurmeta, F. M., & Dewi, C. (2020). Developing Digital Comics as Character Learning Media for Elementary School Students. *Jurnal Ilmu Pendidikan*, 26(2), 47. <https://doi.org/10.17977/um048v26i2p47-53>
- Salamuddin, S., & Fadilah, S. (2022). The Use of Comic Media to Increase the Maharah Qiraah of Elementary Education Level Students. *Edukatif: Jurnal Ilmu Pendidikan*, 4(5), 6530–6537. <https://doi.org/10.31004/edukatif.v4i5.3746>
- Sanory, S. M. (2019). Pengaruh Metode Debat Aktif Dalam Pembelajaran Outdoor Learning Terhadap Kemampuan Berpikir Kritis Peserta Didik Kelas X Pada Matapelajaran Biologi Di SMAN 7 Bandar Lampung. *Skripsi*. Lampung : Universitas Lampung
- Saputra, H., & Pasha, D. (2021). Comics as Learning Medium During the Covid-19 Pandemic. *Proc. Internat. Conf. Sci. Engin*, 4(February), 330–334.
- Senen, A., Sari, Y. P., Herwin, H., Rasimin, R., & Dahalan, S. C. (2021). The use of photo comics media: Changing reading interest and learning outcomes in elementary social studies subjects. *Cypriot Journal of Educational Sciences*, 16(5), 2300–2312. <https://doi.org/10.18844/cjes.v16i5.6337>
- Sudarmo, S., Arifin, A., Jacob Pattiasina, P., Wirawan, V., & Aslan, A. (2021). The Future of Instruction Media in Indonesian Education: Systematic Review. *AL-ISHLAH: Jurnal Pendidikan*, 13(2), 1302–1311. <https://doi.org/10.35445/alishlah.v13i2.542>
- Susanto, T. T. D., Dwiyantri, P. B., Mariani, A., Sagita, J., Safitri, D., & Soraya, E. (2022). E-Book with Problem Based Learning to Improve Student Critical Thinking in Science Learning at Elementary School. *International Journal of Interactive Mobile Technologies*, 16(20), 79–97. <https://doi.org/10.3991/ijim.v16i20.3173>
- Tamami, F., Rokhmat, J., & Harjono, A. (2022). Validation of Go-Lab Based Inquiry Learning Spaces (ILS) on Science Subject for Junior High School Student. *Jurnal Penelitian Pendidikan IPA*, 8(4), 1724–1729. <https://doi.org/10.29303/jppipa.v8i4.2174>
- Udayani, N. K. R. T. K., Wibawa, I. M. C., & Rati, N. W. (2021). Development Of E-Comic Learning Media On The Topic Of The Human Digestive System. *Journal of*

Education Technology, 5(3), 472–481.
<https://doi.org/10.23887/jet.v5i3.34732>

Yolida, B., Marpaung, R. R. T., Priadi, M. A., Sulika, A., & Prajoko, S. (2022). The Effect of the Edmodo-Assisted Discovery Learning Model on Students' Scientific Literacy Ability. *Biosfer: Jurnal Tadris Biologi*, 13(2), 125–134.
<https://doi.org/10.24042/biosfer.v13i>

2.14191

Yulianti, D., Khanafiyah, S., & Sulistyorini, S. (2016). Inquiry-based science comic physics series integrated with character education. *Jurnal Pendidikan IPA Indonesia*, 5(1), 38–44.
<https://doi.org/10.15294/jpii.v5i1.5787>