



Development of Electronic Student Worksheets (E-LKPD) Based on Problem Based Learning to Improve Student Learning Outcomes on Reaction Rate Material

Zeilla Ramadhani Zain*, Ahmad Nasir Pulungan

Departement Chemistry Education, Faculty of Mathematics and natural Science, Universitas Negeri Medan, Jl. William Iskandar, Pasar V, Medan, Indonesia

*Correspondinge-mail: <u>nasirpl@unimed.ac.id</u>, <u>ramadhanizeilla@gmail.com</u>

Received: Jan 12th, 2025 Accepted: Jan 27th, 2025 Online Published: April 25th, 2025

Abstract: Development of Electronic Student Worksheets (E-LKPD) Based on Problem Based Learning to Improve Student Learning Outcomes on Reaction Rate Material. The purpose of this research is to determine the analysis of student needs, the feasibility of e-LKPD, student learning outcomes, teacher responses, and student responses to the problem based learning e-LKPD that was developed. The development method used is the research and development (R&D) method with the 4D development model (Define, Design, Develop and Disseminate). This research is limited to the development stage. The research design uses a one group pretest-posttest design. The research subjects were 36 students at MAS Plus Al-Ulum Medan. The data collection techniques used were teacher interviews, student needs analysis, material and media validation sheets, learning outcome test instruments, teacher response questionnaires and student responses. Based on the results of the analysis of e-LKPD needs at MAS Plus Al-Ulum Medan, it was stated that they needed e-LKPD teaching materials based on problem based learning and as many as 100% of students stated that they agreed to develop e-LKPD based on problem based learning to support learning activities. The results of the feasibility test by material and media expert validators obtained an average percentage of 84.10% with the criteria "very feasible". The n-gain test results obtained were 0.75% with the "high" criteria. The results of the teacher's response obtained a percentage of 90.90% with the criteria "very good". And the results obtained from student responses were a percentage of 88.05% with the criteria "very good". So it can be concluded that the problem based learning based e-LKPD that was developed is suitable and good for use in the learning process and can improve student learning outcomes on reaction rate material.

Keywords: E-LKPD, Problem Based Learning, Learning Outcomes, Reaction Rate

Abstrak: Pengembangan Lembar Kerja Peserta Didik Elektronik (E-LKPD) Berbasis Problem Based Learning untuk Meningkatkan Hasil Belajar Siswa pada Materi Laju Reaksi. Tujuan dari penelitian ini untuk mengetahui analisis kebutuhan siswa, kelayakan e-LKPD, hasil belajar siswa, respon guru, dan respon siswa terhadap e-LKPD berbasis problem based learning yang dikembangkan. Metode pengembangan yang dilakukan adalah metode research and development (R&D) dengan model pengembangan 4D (Define, Design, Develop, and Disseminate). Penelitian ini dibatasi sampai pada tahap develop. Desain penelitian menggunakan one group pretestposttest design. Subjek penelitian sebanyak 36 siswa di MAS Plus Al-Ulum Medan. Teknik pengumpulan data yang digunakan wawancara guru, analisis kebutuhan siswa, lembar validasi materi dan media, instrumen tes hasil belajar, angket respon guru serta respon siswa. Berdasarkan hasil analisis kebutuhan e-LKPD di MAS Plus Al-Ulum Medan menyatakan membutuhkan bahan ajar e-LKPD berbasis problem based laerning dan sebanyak 100% siswa

Zeilla Ramadhani Zain, Ahmad Nasir, Development of Electronic Student ... 59

menyatakan setuju dikembangkan e-LKPD berbasis problem based learning sebagai penunjang kegiatan pembelajaran. Hasil uji kelayakan oleh validator ahli materi dan media didapatkan rata-rata persentase yaitu sebesar 84,10% dengan kriteria "sangat layak". Hasil uji n-gain didapatkan yaitu sebesar 0,75% dengan kriteria "tinggi". Hasil respon guru didapatkan persentase yaitu sebesar 90,90% dengan kriteria "sangat bagus". Dan hasil respon siswa didapatkan persentase yaitu sebesar 88,05% dengan kriteria "sangat bagus". Maka dapat disimpulkan bahwa e-LKPD berbasis problem based learning yang dikembangkan layak dan bagus untuk digunakan dalam proses pembelajaran dan dapat meningkatkan hasil belajar siswa pada materi laju reaksi.

Kata kunci: E-LKPD, Problem Based Learning, Hasil Belajar, Laju Reaksi

• INTRUDUCTION

Chemistry lessons are a part of Natural Sciences (IPA). Chemistry is a science that studies the structure of matter, the properties of matter, the change of one material into another material, and the energy that accompanies changes in matter. The essence of chemistry includes two inseparable things, namely chemistry as a product and chemistry as a process. Chemistry as a product includes a collection of knowledge consisting of facts, concepts and principles possessed by scientists to obtain and develop chemical knowledge. Chemistry as a process includes the skills and attitudes possessed by scientists to acquire and develop chemical knowledge (Suswati, 2021).

Teaching materials are very important in the teaching and learning process because they can strengthen and support the teaching material information presented by the teacher. Teaching materials help students understand scientific concepts to achieve the desired competencies so that they are easy to remember and can be repeated (Ritonga et al., 2022) Teaching materials play an important role for teachers and students as a medium for achieving competence because communication exists between readers and resource persons. Teaching materials must contain the vision, mission, context, content and personal process of the information presented so that they can motivate students to learn (Magdalena et al., 2020).

Based on the results of interviews conducted with chemistry subject teachers at MAS Plus Al-Ulum Medan, namely the curriculum used was curriculum 13 and the KKM score was 82, several problems were found, including that the teacher only used minimal teaching materials, namely in the form of chemistry textbooks provided. by the school library. The available textbooks are also generally thick in size, which results in students' lack of interest in reading. Learning is carried out using discussion, lecture methods and is still teacher-centred. The appropriateness of using this method depends on the material being taught. Teachers have not utilized information technology, so they have never developed LKPD electronic teaching materials. It was also said that one of the materials that is difficult for students to understand is the reaction rate material.

Chemistry is considered a difficult subject for upper secondary students because students often experience it difficulty in understanding abstract concepts that cause students to understand differently ideas (Musengimana et al., 2021). Students' difficulties in understanding chemistry This is because chemistry is an abstract and complex concept that requires in-depth study broader understanding in studying it (Sariati et al., 2020).

Chemistry learning must be able to adjust the learning model to maximize chemistry learning. One of the materials studied in chemistry is reaction rate material. Reaction rate is one of the chemical materials that requires critical thinking skills, which

is studied in class XI SMA/MA and is material that is closely related to everyday life (Dewi et al., 2020). Learning models are needed to help students describe reaction rates so that abstract concepts can be proven, namely by using a problem based learning model of student learning outcomes on reaction rate material.

The problem based learning model is a learning model that teachers can use in accordance with the problems above and with the 2013 curriculum. This model stimulates students to be able to solve problems given by the teacher. The problem based learning model is a learning model that uses real world problems as a context, as a stimulus for students' critical thinking abilities and problem solving abilities in understanding the concepts and principles that are essential to a subject. The problem based learning model has the advantage of developing critical thinking skills and student learning outcomes as well as adapting to new knowledge because it helps transfer their knowledge to understand problems (Dewi et al., 2020). The syntax of the problem-based learning model is orientation towards problems, organizing students, investigating and guiding groups, developing and presenting work results as well as evaluating and solving problems (Farhana et al., 2023).

In today's digital era, information technology plays an important role in the learning process. One of the innovations developed is the use of e-LKPD (Electronic Student Worksheet) as a supporting medium in implementing the problem based learning model. E-LKPD is a LKPD developed as a learning medium that can support the learning process through various innovations in the use of electronic media. E-LKPD is used to deliver material with the aim of improving students' thinking abilities, through interactive e-LKPD it will make understanding the material easier. This e-LKPD can be accessed easily via smartphone or laptop. Apart from that, to increase e-LKPD innovation and to make it easier to use the e-LKPD created, the application that can be used is liveworksheets. These web live worksheets can be in the form of images, audio, text, animation and video as an innovation for e-LKPD development. Through the steps and instructions in the e-LKPD, students are directed to follow the learning and complete the practice questions given properly (Wahyuni et al., 2021).

Previous research conducted by Nurmasita et al. (2022) based on the results of their research, namely the results of The assessment of the appropriateness of the material, graphics and language respectively was 94.1%, 95.4% and 90.8%, including very appropriate criteria. Results The teacher's response stated that e-LKPD included very good criteria with an average percentage of 87.8%. Test student response results individual 74.7% good criteria, small group test 76.5% good criteria and field tests 83.4% including very good criteria. Based on data The results of the analysis can be concluded that e-LKPD is Problem Based Laerning can be applied in chemistry learning, especially in redox reaction material.

From the description of the problem above, researchers are interested in developing e-LKPD teaching materials based on problem based learning on reaction rate material in order to create a pleasant learning atmosphere, increase students' understanding of the material and foster student effectiveness and participation in the learning process. Students will be trained independently so they can solve or solve problems independently in learning.

• METHOD

This research is a type of research and development (Research and Development). The development model used in this research is 4D. The 4D model consists of 4 development stages, namely: Define, Design, Develop and Disseminate (Harjanto et al., 2022). Based on the research results, this research will produce products that suit the researchers' needs.

This research will be carried out at the MAS Plus Al-Ulum Medan school which is located on Jalan Puri, Kotamatsum III, Kec. Medan Area, Medan City. Sample collection used purposive sampling technique. According to Chan et al. (2022) the purposive sampling technique is a sampling technique with certain considerations, namely by directly selecting one class, namely Class XI IPA-2 as a sample. In this research, researchers used a one group pretest-posttest design. The data analysis techniques used in this research are media feasibility test analysis, teacher response questionnaire analysis, student response analysis, and n-gain test analysis.

The development procedure in this research is the Define stage, namely the stage for defining and determining a learning need. This stage begins with an analysis of student needs by distributing questionnaires to students and conducting interviews with teachers. After the needs analysis, proceed with formulating learning objectives in accordance with student learning needs. Design Stage, namely the stage for designing the resulting product which has been designed in accordance with the definition analysis both in terms of material selection and format selection. Development stage, namely the stage to realize the product design that has been designed, then validated by experts, apart from that at this stage there are also revisions from various experts in the field according to suggestions and input, then tested on teachers and students.

• RESULT AND DISCUSSION

E-LKPD based on problem based learning on reaction rate material which was developed using the 4D development model has 4 stages of define, design, development and disseminate, however the development carried out is only limited to the third stage, namely the development stage.

The first stage is the define stage. At this definition stage, an initial condition analysis is carried out which aims to provide an overview and guidelines for product development to suit school needs. Based on the initial analysis carried out by conducting interviews with chemistry teachers, it shows that learning in schools uses curriculum 13. Therefore, teachers hope for the development of innovative learning media that makes it easier for students in the learning process. Apart from that, the results obtained based on the distribution of student needs questionnaires can be seen in table 1.

No	Question	Answer Choices	%
1.	What do you think about the chemistry lessons	Pleasant	50%
	given by the teacher?	Unpleasant	40%
		Boring	10%
2.	Does the material provided by the teacher match	Suitable	40%
	your daily needs?	Less suitable	60%
3.	What teaching materials do teachers use in	Textbook	100%
	chemistry lessons?		
4.		Good	60%

 Table 1. Analysis of Student Needs

	How does the teacher learn when delivering chemistry material?	Explaining too	40%
5.	What obstacles do you experience during the	Doesn't understand	60%
	process of learning chemistry in the classroom?	Difficult	30%
		No obstacles	10%
6.	In studying chemistry, what material do you find	Reaction rates	70%
	difficult?	Redox	20%
		Almost all	10%
		chemistry lessons	
7.	Do you understand well the reaction rate material	No	30%
	presented by the teacher?	Less	70%
8.	What is your level of understanding in the reaction	Good	10%
	rate material?	Less	30%
		Moderate	60%
9.	Does the teacher use additional media during the	Yes	100%
	chemistry learning process in class?		
10.	In your opinion, is it necessary to develop	Very	100%
	electronic LKPD on reaction rate material?	necessary/agree	

Based on the results of the needs analysis questionnaire that has been submitted, it can be seen that the majority of class From these problems, it is hoped that interesting e-LKPD products can be produced and can increase student motivation.

The second stage is the design stage. At this stage the researcher carried out several steps, namely selecting material and selecting format.

The third stage is the development stage. At this stage is the development of e-LKPD products based on problem based learning. The e-LKPD products produced are in accordance with the e-LKPD framework. The applications used to create e-LKPD are jokes and web live worksheets to make LKPD into interactive e-LKPD. The activity carried out was designing a product in the form of an e-LKPD using a problem based learning model and structured based on the syntax stages of the problem based learning model. The stages of the learning model are problem orientation, organizing students, investigating and guiding groups, developing and presenting work results as well as evaluating and solving problems.

1. E-LKPD Feasibility Test

The problem based learning based e-LKPD that has been developed is then validated by material experts and media experts to see the feasibility level of the e-LKPD product being developed. The validators, material experts and media experts, are lecturers in the chemistry department at Medan State University. The aspects assessed by material experts are the appropriateness aspect of the content, the problem based learning approach aspect, and the language aspect. The following assessment of the average validation results of material experts can be seen in table 2.

	Average Per	Average (%)	
Mareial	VI	V II	83.82
Expert	77,94	89,70	
E	igibility Level Cri	iteria	Very Worthy

Table 2 Average Result of Material Expert Validation

Furthermore, validation was carried out by media experts, according to Rahman et al. (2021) who said that in the process of making good media Certain design aspects must be paid attention to in order to produce good media and with an attractive appearance.

There are several aspects that are assessed by media experts, namely the e-LKPD component aspects, cover design, content display, and live worksheet media. The following assessment of the average validation results of media experts can be seen in table 3.

Average Percentage (%) Average (%) VΙ VП Media Expert 84,38 80 88,75 **Eligibility Level Criteria** Very Worthy

 Table 3. Average Result of Media Expert Validation

Table 4. Overall Assessment by Expert Validators			
	Average (%)		
Materi Expert	83,82		
Media Expert	84,38		
Average Eligibility Percentage	84,10		
Eligibility Level Criteria	Very Worthy		

This percentage was obtained from the total average percentage of validation from material experts and media experts and obtained an average percentage of 84.10% with the eligibility criteria being "very feasible". This is also accompanied by suggestions and input from material expert validators and media experts.



Figure 1. Diagram of the Average Validator Assessment Results

The research results of Sari et al. (2022) The resulting E-LKPD has been tested by obtaining a validity level of 83% (valid). From these results, it was identified that the e-LKPD that was tested was suitable to be used as additional teaching material for teachers in schools. In line with research conducted by Zulfah & Novitas (2022) E-LKPD the problem solving developed was declared suitable for use in the learning process.

Development was carried out based on suggestions for improvements from the validator obtained as shown in table 5 and table 6.

Suggestion	Before Revision	After Revision	
Image source improvements	Reaksi Eksoterm (melepa Kilor) di funzi funzi - Ponunci	Redel Excertors (molecus Kalor) artual Rese: - Power build a sector of the sector and the sector of the sector and the secto	
Unit writing improvements	eceBahan :1. Gula halus : 250 gram2. Air panas : 100 ml3. Air biasa : 100 ml4. Air dingin : 100 ml	eveBahan :1. Gula halus : 250 gram2. Air panas : 100 mL3. Air biasa : 100 mL4. Air dingin : 100 mL	
Improving word writing	Berdasarkan informasi yang telah didapatkan, buatkanlah kesimpulan dan presentasikanlah hasil diskusi kelompok ananda solusi dari pemecahan masalah yang telah didiskusikan!	Berdasarkan informasi yang telah didapatkan, buatkanlah kesimpulan dan presentasikanlah hasil diskusi kelompok kelian solusi dari pemecahan masalah yang telah didiskusikan!	

Table 5. Suggestions for Improvement from Material Experts

Table 6. Suggestions for Improvement from Media Experts

Suggestion	Before Revision	After Revision
Correction of answer column	Image: A constraint of the menupagina of the image o	A Integrationagian dan menyajikan hasi karap Terrangkan dan menyajikan hasi karap Terrangkan dan menyajikan hasi karap Terrangkan dan dan dan dan dan dan dan dan dan d

Zeilla Ramadhani Zain, Ahmad Nasir, Development of Electronic Student ... 65

2. N-Gain Test of Learning Outcomes

The author tested the product on test subjects. This testing was carried out with the aim of improving student learning outcomes and testing the attractiveness of the e-LKPD which had been developed based on student assessments.

Researchers carried out a trial phase on 36 students of MAS Plus Al-Ulum Medan class XI IPA-2 as an experimental class. Then, an initial test (pretest) is given, where the pretest questions are 20 questions that meet the requirements in terms of validity, reliability, level of difficulty, different power test, and distractors. The use of the pretest is to determine students' initial abilities. The average pretest score was 25.14.

During the trial, the author gave the e-LKPD link to 36 students so that they could open their smartphones. Students looked enthusiastic after the students operated the e-LKPD. After the learning activities are completed, a posttest is held to determine student learning outcomes after receiving treatment. The average posttest score was 81.25. The results of the pretest and posttest are then tabulated to get the value of increasing student learning outcomes (N-Gain) using Ms Excel 2013. The average gain result from the pretest and posttest data is 0.75 with a division category (N-Gain) score of "High".

Based on the research results, data obtained from the pretest and posttest were analyzed via the Ms. application. Office Excel 2013, average pretest, posttest and gain data (increase in student learning outcomes).

Tuble 7. Tivetage Tretest, Tostest and Gam result					
	Ν	Minimum	Maximum	Average	
Pretest	36	10	40	25,14	
Posttest	36	65	90	81,25	
Gain	36	0,59	0,88	0,75	

Table 7. Average Pretest, Posttest and Gain result



The average pretest and posttest data are presented in Figure 2.





Figure 3. Diagram of the Average Increase in Learning Outcomes

Based on previous research by Subandi et al. (2023) The developed E-LKPD is feasible, practical and can be used as teaching material. This e-LKPD can be used as an interesting learning resource and is able to improve student learning outcomes through problem-based learning. In line with research conducted by Marbun et al. (2023) The e-LKPD based on problem based learning that was developed showed that students' chemistry learning outcomes were higher than the minimum completeness criteria (KKM). This means that electronic student worksheets with problem based learning models are suitable for use as media or learning resources in learning.

3. Teacher Response to E-LKPD Based on Problem Based Learning

To find out teachers' responses to e-LKPD based on problem based learning, namely by collecting data using a teacher response questionnaire which contains several statements. The average results of the teacher response questionnaire can be seen in table 8.

	Ν	Total Score	Maximum Score	Average (%)
Student	1	40	44	90,90
Response				

 Table 8. Average teacher response



Figure 3. Diagram of Average Teacher Responses

In previous research by Mairani et al. (2022) E-LKPD Based on Problem Based Learning (PBL) on Hydrocarbon Material which was developed obtained an average percentage score of 90% with a very good category for teacher responses. So that e-LKPD can be used as a student learning resource.

4. Student Responses to E-LKPD Based on Problem Based Learning

After the product validation and revision process has been completed and has been declared feasible by material expert validators and media experts, the E-LKPD product based on problem based learning was tested at MAS Plus Al-Ulum Medan with a large group of 36 students as test subjects. class XI IPA-2. This trial was carried out to determine students' responses to the e-LKPD being developed.

To find out students' responses regarding the use of E-LKPD after learning activities, students were given an assessment sheet related to the use of E-LKPD. This assessment is reviewed from the appearance aspect, content or material aspect, usefulness aspect and language aspect. The following are the results of data analysis of the average

results of filling out student response questionnaires from large group trials which are presented in table 9 below:

	Ν	Skor Score	Maximum Score	Average (%)
Student	36	1775	2016	88,05
Response				

Table 9. The average result of student response

In table 9 above, the results of a large group trial were 36 students in class XI IPA-2 MAS Plus Al-Ulum Medan who had studied reaction rates using E-LKPD. It can be seen that the average value of students' responses to E-LKPD is 88.05%, which means that E-LKPD is in the "very good" criteria. Data on the average percentage of student responses is presented in Figure 4.



Figure 4. Diagram of Average Student Response

At the implementation stage, when students look enthusiastic in using the e-LKPD being developed, this can support the percentage of student satisfaction that researchers get because it refers to these questions. Students will be more active and feel satisfied if the learning media used suits their needs. Students' interest in learning media is based on how interesting the learning media is to what students want (Nurfadillah et al., 2021).

In previous research by Sari & Purwaningsih (2019) In previous research conducted by Sari & Purwaningsih (2019), the E-LKPD based on Problem Based Learning (PBL) that was developed obtained a score of 92.11% (very good). Based on the research results, the e-LKPD developed for science learning has received a very good response from students so that it can be used as a learning resource.

In line with previous research conducted by Khairunisa et al. (2024) shows that the feasibility level of developing interactive LKPD based on augmented reality media on chemical equilibrium material has been validated by media experts with a total average percentage score obtained from media experts of 95% with the criteria "very feasible". So overall the LKPD Interactive is a media based on augmented reality on chemical equilibrium material that has been developed and is suitable for use in the learning process, especially on chemical equilibrium material and students' assessment of the attractiveness of interactive LKPD based on augmented reality media on equilibrium material The chemistry developed obtained an average percentage of 76% with the "interesting" criteria. So it can be concluded that overall the interactive LKPD product

based on augmented reality media on balance material is interesting for students to learn to use in the learning process, especially in the material chemical equilibrium.

• CONCLUSION

Based on the results of the analysis of the need for e-LKPD based on problem based learning at MAS Plus Al-Ulum Medan, they stated that they needed e-LKPD teaching materials based on problem based learning on reaction rate material and as many as 100% of students stated that they agreed to develop teaching materials in the form of LKPD in electronic form. based on problem based learning as a support for learning activities. The feasibility level of e-LKPD based on problem based learning on reaction rate material based on assessments by material expert validators and media validators resulted in an average percentage of 84.10% with very feasible criteria results obtained. The learning outcomes of students taught using e-LKPD based on problem based learning on reaction rate material which is known from the n-gain test results is 0.75% in the high category. E-LKPD based on problem based learning on reaction rate material based on the results of the teacher response questionnaire was declared very good with a percentage of 90.90% in the very good category. And based on the results with a percentage of 88.05% in the very good category.

• **REFERENCES**

- Chan, F., Kurniawan, A. R., Kalila, S., Amalia, F., Apriliani, D., & Herdana, S. V. (2019). The Impact of Bullying On The Confidence of Elementary School Student. *Jurnal Pendas Mahakam*, 4(2), 152-157.
- Dewi, C., Utami, L., & Octarya, Z. (2020). Pengaruh Model Pembelajaran Inkuiri Terbimbing Integrasi Peer Instruction Terhadap Kemampuan Berpikir Kritis Siswa SMA Pada Materi Laju Reaksi. *Journal of Natural Science and Integration*, 3(2):196–204.
- Dewi, R., Gustiawati R., & Afrinaldi, R. (2020). Implementasi Model Pembelajaran Problem Based Learning Dalam Pembelajaran Pendidikan Jasmani Di SMA Negeri 4 Karawang. *Journal Coacing Education Sports*, 1(2):85–92.
- Farhana, A., Yuanita, P., Kartini, K., & Roza, Y. (2023). Deskripsi Kendala Guru Menerapkan Model Pembelajaran Problem Based Learning Pada Pembelajaran Matematika. *Mathema: Jurnal Pendidikan Matematika*, 5(2), 126-137.
- Khairunnisa, D., Juwita, I., Putra, A. S., Egya, J. M., Bangun, K. W. B., & Muchtar, Z. (2024). Development of Interactive LKPD Based on Augmented Reality Media on Chemical Equilibrium Material. *Jurnal Pendidikan dan Pembelajaran Kimia*, 13(3). <u>https://jurnal.fkip.unila.ac.id/index.php/JPK/article/view/32181</u>
- Magdalena, I., Wahidah, E. R., Rahmah, G., & Maharani, S. C. (2020). Pembelajaran Inovatif Dalam Pembentukan Karakter Siswa Kelas 1 Sd Negeri Pangadegan 2. *PENSA: Jurnal Pendidikan Dan Ilmu Sosial*, 2(3):376–92. https://ejournal.stitpn.ac.id/index.php/pensa/article/view/1015
- Mairani, U., Enawaty, E., Sartika, R. P., Muharini, R., & Rasmawan, R. (2022). Pengembangan Lembar Kerja Peserta Didik Elektronik (E-LKPD) Berbasis Problem Based Learning (PBL) pada Materi Hidrokarbon. Journal Education and Development, 10(3), 117-121. <u>https://doi.org/10.37081/ed.v10i3.3848</u>
- Marbun, E., Sitorus, M., & Tarigan, S. (2023, December). Development of Chemistry

Electronic Student Worksheets Problem Based Learning Model to Improve Student's Learning Outcome in Grade X Senior High School on Stoichiometry Topic. In *Proceedings of the 8th Annual International Seminar on Transformative Education and Educational Leadership, AISTEEL 2023, 19 September 2023, Medan, North Sumatera Province, Indonesia.*

- Musengimana, J., Kampire, E., & Ntawiha, P. (2021). Factors Affecting Secondary Schools Students' Attitudes toward Learning Chemistry: A Review of Literature. Eurasia Journal of Mathematics, Science and Technology Education, 17(1), 1–12. https://doi.org/10.29333/ejmste/9379
- Nurmasita, N., Enawaty, E., Lestari, I., Hairida, H., & Erlina, E. (2023). Pengembangan e-LKPD Berbasis Problem Based Learning (PBL) pada Materi Reaksi Redoks. *Jambura Journal of Education Chemistry*, 5(1), 11-20.
- Nurfadhillah, S., Ningsih, D. A., Ramadhania, P. R., & Sifa, U. N. (2021). Peranan Media Pembelajaran dalam Meningkatkan Minat Belajar Siswa SD Negeri Kohod III. *Pensa*, 3(2), 243-255.
- Rahman, F. Y., Karyadiputra, E., Setiawan, A., & Purnomo, I. I. (2021). Pelatihan Pembuatan Media Pembelajaran Buku Digital Menggunakan Flipbook pada sdit sullamul'ulum. ABDINE: Jurnal Pengabdian Masyarakat, 1(2), 87-93.
- Ritonga, A. P., Andini, N. P., & Iklmah, L. (2022). Pengembangan bahan ajaran media. Jurnal Multidisiplin Dehasen (MUDE), 1(3), 343-348.
- Sariati, N. K., Suardana, I. N., & Wiratini, N. M. (2020). Analisis Kesulitan Belajar Kimia Siswa Kelas Xi Pada Materi Larutan Penyangga. Jurnal Imiah Pendidikan Dan Pembelajaran P-ISSN : 1858-4543 e-ISSN : 2615-6091, 4(April 2020), 1–12.
- Sari, A. A., & Purwaningsih, D. (2019). Pengembangan E-LKPD Berbasis Problem Based Learning (PBL) Dengan Liveworksheets Pada Materi Asam Basa. Jurnal Ilmiah WUNY 5(2):13–26. <u>https://doi.org/10.21831/jwuny.v5i2.66387</u>
- Sari, D. N. I., Budiarso, A. S., & Wahyuni, S. (2022). Pengembangan E-LKPD Berbasis Problem Based Learning (PBL) Untuk Meningkatkan Kemampuan Higher Order Thinking skill (HOTS) pada Pembelajaran IPA. Jurnal Basicedu 6(3):524–32.
- Subandi, I. P., Sudzuasmais, Triana, A. D., & Hidayah, R. (2023). "Pengembangan E-LKPD Berbasis Problem Based Learning untuk Meningkatkan Hasil Belajar Peserta Didik pada Materi Minyak Bumi di Era Merdeka Belajar." UNESA Journal of Chemical Education 12(1):59–66. <u>https://doi.org/10.26740/ujced.v12n1.p59-66</u>
- Suswati, U. (2021). Penerapan Problem Based Learning (PBL) Meningkatkan Hasil Belajar Siswa. TEACHING: Jurnal Inovasi Keguruan Dan Ilmu Pendidikan, 1(3):127–36. <u>https://doi.org/10.51878/teaching.v1i3.444</u>
- Wahyuni, K. S. P., Candisa, I. M., & Wibawa, I. M. C. (2021). Pengembangan E-LKPD Berbasis Kemampuan Berpikir Tingkat Tinggi Mata Pelajaran Tematik Kelas IV Sekolah Dasar. *PENDASI Jurnal Pendidikan Dasar Indonesia*, 5(2), 301-311. <u>https://doi.org/10.23887/jurnal_pendas.v5i2.476</u>
- Zulfah, F. H., & Novita, D. (2023). Development of problem-solving e-worksheet to improve problem-solving skills in reaction rate materials. *Jurnal Pendidikan dan Pembelajaran Kimia*, 12(2), 126-137.