

# Problem Solving-Oriented E-Worksheet To Train Students' Metacognitive Skills On Acid-Base Titration Material

Salsabila Almas Dwi Ranti\*, Utiya Azizah\*\*

\* Chemistry Education, Universitas Negeri Surabaya, Indonesia

\*\* Chemistry Education, Universitas Negeri Surabaya, Indonesia

DOI: 10.29322/IJSRP.14.02.2024.p14636

<https://dx.doi.org/10.29322/IJSRP.14.02.2024.p14636>

Paper Received Date: 19th January 2023

Paper Acceptance Date: 20th February 2024

Paper Publication Date: 29th February 2024

**Abstract-** This study aims to obtain the feasibility of problem solving-oriented e-worksheet to train students' metacognitive skills on acid-base titration material in terms of validity, practicality, and effectiveness criteri. This type of research is research and development (R&D). At the product trial stage, it was conducted in a class of Senior High School that consisting of 21 students. Validity was obtained from a validation sheet filled out by 3 validators. Based on the validation sheet in terms of content, presentation, linguistic, and graphical feasibility aspects have a mode score  $\geq 3$  so that it is declared valid. Practicality was obtained from a response questionnaire filled by 21 students Senior High School. Based on the response questionnaire, the overall practicality level of the developed problem solving-oriented e-worksheet is 89.88% (very good). Effectiveness is obtained from the pretest and posttest of metacognitive skills. Based on the students' metacognitive skills test, the N-gain value was obtained, namely: (1) Planning Skills 0.72, (2) Monitoring Skills 0.73, and (3) Evaluating Skills 0.71. In addition, the data from the skills test results were analyzed using the paired sample t-test of metacognitive skills obtained a sig value. (2-tailed) of 0.000 which can be interpreted that there are differences in the meta-cognitive abilities of students before and after using problem solving-oriented e-worksheet based on the results of validity, practicality, and effectiveness, the e-worksheet developed is said to be feasible.

**Index Terms-** e-worksheet; problem solving; metakognitif skills; acid-base titration

## I. INTRODUCTION

The outbreak of the pandemic became the point where the education system in Indonesia experienced drastic changes. The impact is clearly visible in the continuity of the learning process which experiences problems, as a result learning activities become less effective. Through Ministerial Decree no. 56 of 2022, the Ministry of Education, Culture, Research and Technology (Kemendikbud) decided to implement an independent curriculum as an effort to restore learning after the pandemic. One of the schools that has implemented the independent curriculum is State Senior High School 1 of Sidoarjo. Students are trained to conduct simple qualitative and quantitative research both individually and collaboratively regarding various real-world phenomena. This is in accordance with the characteristics of metacognitive skills, namely how students think about how they think and their ability to use certain learning strategies appropriately (Slavin, 2010).

According to Azizah and Nasrudin (2021) metacognitive skills are a continuous process which requires learning effort and exercise. Pulmones (2008) said that there are three skills that refer to the dimension of metacognitive skills, namely planning skills, monitoring skills and evaluating skills. Metacognitive skills are fundamental in preparing to learn something, monitoring improvements in learning outcomes, and correcting what has been learned in solving a problem (Azizah et al., 2019).

Based on the results of pre-research at State Senior High School 1 of Sidoarjo which was given to 33 students in the form of acid-base titration questions based on metacognitive skills, that is, 41% of students were able to understand important information contained in the questions such as mentioning tools and materials for acid-base titration practice, so it can be said that students' planning skills are still low. As many as 41% of students were able to determine strategies in solving problems such as relating how to determine acid concentration with the titration method. From this it can be said that the monitoring skill component of students is still low. As many as 36% of students were able to evaluate answers to problem solving, such as knowing the reasons why using the titration method the unknown acid concentration became known, so it could be said that students' evaluating skills were still low. Based on this, students at State Senior High School 1 of Sidoarjo are not yet accustomed to empowering metacognitive skills.

Chemistry is a science that studies the composition of substances, the properties of substances, changes in the composition or properties of substances, changes in energy that occur when a substance undergoes changes Azizah et al. (2017). The results of the pre-

research questionnaire at State Senior High School 1 of Sidoarjo, as many as 60.4% of students stated that chemistry was a difficult subject. According to Murni et al. (2021) one of the chemical materials, namely acid-base titration material, is still considered abstract.

The results of the pre-research questionnaire at State Senior High School 1 of Sidoarjo stated that 75% of students stated that the acid-base titration material was difficult material. The characteristics of chemistry can be seen from three aspects, namely macroscopic, microscopic and symbolic aspects (Ristiyani & Bahriah, 2016). In the acid-base titration material it covers all aspects of chemistry, in the macroscopic aspect there are color changes that can be directly observed, in the symbolic aspect there are equations written in the acid-base titration neutralization reaction, in the microscopic aspect there is an abstract representation of the changes that occur in the macroscopic aspect. Educational Standards, Curriculum and Assessment Agency (BSKAP) Decree Number 33 of 2022 states that in chemistry subjects students learn to find problems, create hypotheses, design simple experiments, conduct experiments, analyze data, draw conclusions and communicate experimental results both in writing and orally (Kemendikbud). This requires students to be actively and independently involved in learning activities by carrying out experiments to identify acid and base titrations so that students are able to understand the learning strategies that will be used to build their own understanding.

One learning model that can support chemistry learning in acid-base titrations is Problem Solving. According to Azizah and Nasrudin (2022) problem solving skills are essential to solving any problem. Therefore, problem solving is considered one of the thinking skills that students must have in the modern era. Polya (Reed, 2000) stated that Problem Solving is looking for a way out of a difficulty, a way out of obstacles, achieving a goal that is not immediately understandable. According to Suhendri & Mardalena (2015) Problem Solving is a systematic learning method consisting of stages of presenting problems to students, then students solving the problem appropriately, and being able to communicate or express opinions verbally about problem analysis and solutions. This is also in accordance with the learning outcomes of the independent curriculum where students learn to find problems, create hypotheses, design simple experiments, conduct experiments, analyze data, draw conclusions and communicate experimental results both in writing and orally. From these several things, the acid-base titration material is suitable for using the problem-solving learning model because of the problem-solving learning steps according to Polya (Reed, 2000) are (1) understand the problem, (2) create a problem-solving plan, (3) implement the problem-solving plan, and (4) re-evaluate the results of the solution.

The learning model used must also be balanced with appropriate teaching materials. Therefore, teachers are expected to develop teaching materials as a learning resource. According to Nopindra & Soleh (2019) Student worksheets or LKPD are learning tools to increase student activity in teaching and learning activities. These 21st century skills include critical thinking and problem solving, creativity and innovation, communication, and collaboration. Redhana (2019) demands that educators also innovate; one way is by developing electronic worksheet or e-worksheet. E-worksheet is a student worksheet that can be used in online learning, anytime and anywhere using media such as laptops or smartphones (Apriliyani & Mulyatna, 2021).

One website that helps develop e-worksheet is Liveworksheet Web. This website has many advantages according to Lathifah dkk. (2019) namely that it is easy to use, practical and has various features that can make worksheet more attractive. The advantages of this web will be utilized by researchers by combining a virtual acid-base titration lab by inserting a link into the e-worksheet being developed. Based on the results of the pre-research questionnaire, 93.8% of students have never done practicum online, therefore the e-worksheet being developed will contain a link for students to do practicum online via the e-worksheet developed by researchers.

## II. LITERATURE REVIEW

### *Electronic Worksheet*

E-worksheet is a student worksheet that can be utilized in online learning, anytime and anywhere using media such as laptops or smartphones (Apriliyani & Mulyatna, 2021). E-worksheet has a relationship with e-learning because it focuses on students (Farkhati & Sumarti, 2019) which is a learning media that is easily accessible via the internet in supporting students' learning activities (Zahroh & Yuliani, 2021). Kurniawati et al. (2021) added that the e-worksheet used by students is in the form of soft files using electronic devices such as gadgets, laptops, and computers. e-worksheet has the same function as student worksheet in general.

One of the websites that helps the development of e-worksheet is Liveworksheet Web, which is a form of design that makes it easier for students to access worksheets and is more flexible and can be accessed via smartphones. Liveworksheets is a web platform with facilities to create student worksheet with interesting and interactive features (Fauzi et al., 2021). By using liveworksheets web as a learning web platform, it can make it easier for students because in using this student worksheet, students only need to open google chrome to access it so they don't need to bother downloading applications on their smartphones. So, with this, students can independently access Interactive e-worksheet with Liveworksheets Web and can be used as learning media to make them more active and learning more effective.

### *Problem Solving Model*

Polya (Reed, 2000) stated that Problem Solving is looking for a way out of a difficulty, a way out of obstacles, achieving a goal that is not immediately understandable. The problem-solving model is a way of presenting course material that focuses on teaching and problem-solving skills followed by reinforcement in skills. The stages of the problem solving learning model according to Polya (Reed, 2000) are (1) understanding the problem, (2) making a problem solving plan, (3) implementing the problem solving plan, and (4) re-evaluating the solution results.

### *Metacognitive Skills*

Metacognitive skills are a process of understanding the control of one's cognition and the ability to monitor the strategies used when learning a task. Metacognitive skills are mental activities in the cognitive structure that consciously organize, control, and examine one's thinking process (Azizah et al., 2019). According to Pulmones (2008) there are 3 components in metacognitive skills, namely: (1) planning skill, (2) monitoring skill, and (3) evaluation skill. Metacognitive skills refer to a person's cognitive activities including comprehension, communication, attention, memory, and problem solving.

**Acid-Base Titration Material**

Acid-base titration or also known as chemical quantitative analysis is used to determine the level of an analyte. This analysis technique is carried out by dripping a solution that has a known concentration to the solution whose concentration is sought using a burette until it reaches the equivalent point. Measurements in titration analysis techniques are carried out based on their volume so that volume measurement in this case is an important point which makes it also referred to as volumetric analysis (Petrucci et al., 2017).

**III. METHODS**

This type of research is carried out using the Research and Development method according to Sugiyono (2022) which is limited to stage 7 with the following description: (1) potential and problems, (2) data collection, (3) product design, (4) study and product revision, (5) product validation, (6) product revision, and (7) product testing.

**Time and Location of Research**

The research was tested at in State Senior High School 1 of Sidoarjo class 11 Science 13 on 11-15 December 2023.

**Research Population and Sample**

The sample for the product trial was 21 students of class 11 Science 13.

**Data analysis**

The data analysis technique used in this research is as follows:

1. Validation Sheet Analysis

Data from validation sheets obtained from 2 chemistry lecturers and a chemistry teacher as validators were used to test the validity of the e-worksheet being developed. The validity results were analyzed by assessing the presence or absence of each indicator using the Likert rating scale in the following table:

**Table 1.** Likert scale validation sheet

Scale	Indicator
1	Not valid
2	Not valid enough
3	Valid
4	Very valid

(Sugiyono, 2022)

The validation data is in the form of ordinal data which can be analyzed by determining the mode for each aspect or indicator with the following conditions:

- a. If the aspect assessed by the validator has a mode value  $\geq 3$ , then the aspect is declared valid.
- b. If the aspect assessed by the validator has a mode value  $< 3$ , then the aspect is declared invalid.

(Lutfi, 2021)

2. Response Questionnaire

Data from student questionnaires are used to measure the practicality of e-worksheet. The score obtained will determine the percentage of practicality of e-worksheet using the following formula:

$$\text{percentage of practicality} = \frac{\sum \text{score obtained}}{\sum \text{maximum score}}$$

This score calculation is obtained based on the Guttman scale calculation in the table 2.

**Table 2.** Guttman scale student response questionnaire

Answer	Positive Answer Score	Negative Answer Score
Yes	1	0
No	0	1

The percentage results are used to determine the practicality of problem solving-oriented e-worksheet using the following categories:

**Table 3.** e-worksheet practicality category

Range	Categories
0-20%	Very Less
21- 40%	Less
41-60%	Enough

Range	Categories
61-80%	Good
81-100%	Very Good

(Sugiyono, 2022)

Based on this category, e-worksheet is said to be practical if the percentage  $\geq 61\%$

### 3. Skills Test Analysis

Student skills test data is obtained from the pretest and posttest results which are used to calculate the normalized Gain (N-Gain) with the following formula.

$$G = \frac{\text{posttest score} - \text{pretest score}}{\text{maximum score} - \text{pretest score}}$$

Then the average score obtained will be interpreted in table 4 of the following gain level criteria:

**Table 4.** Gain Level Criteria

G	Categories
Gain $\geq 0,7$	High
$0,3 \leq \text{n-gain} < 0,7$	Medium
n-gain $< 0,3$	Low

(Hake, 1999)

Students' metacognitive skills can be stated to have increased and the learning media developed is categorized as effective if the N-Gain value ( $\langle g \rangle \geq 0,3$ ).

Pretest and posttest score data were also analyzed using SPSS with the T-Test. The following are the steps for carrying out the T-Test:

#### a. Normality test

The normality test is a requirement for conducting paired sample t-test analysis. Before carrying out the paired sample t-test, the data must be tested for normality using the Kolmogrov Smirnov test. The Kolmogrov Smirnov test is used to test paired data between 20-1000 (Putri, 2020). Data is said to be normal if the significant value is  $>0.05$  (R. D. Putri, 2020). The normality test was carried out using SPSS with the following basis for decision making:

- 1) If the significance value is  $> 0.05$  then the data is declared normally distributed.
- 2) If the significance value is  $\leq 0.05$ , then the data is declared not normally distributed.

(Wahab dkk., 2021)

#### b. Paired Sample T-Test

The paired sample t-test is part of parametric statistical analysis. The paired sample t-test is a difference test used to see the significance of the difference between pretest and posttest scores (Wahab dkk., 2021). The paired sample t-test was carried out using SPSS.

The hypothesis used in this test is:

$H_0$ : There is no influence from implementing problem solving-oriented e-worksheet in training students' metacognitive skills (there is no average difference between pretest and posttest metacognitive skills).

$H_1$ : There is an influence from the application of problem solving-oriented LKPD in training students' metacognitive skills (there is an average difference between the pretest and posttest metacognitive skills)

The decision making for this test is based on the significance value. The explanation is as follows:

- If the significance value is  $<0.05$  then  $H_0$  is rejected and  $H_1$  is accepted
- If the significance value is  $\geq 0.05$  then  $H_0$  is accepted and  $H_1$  is rejected

(Wahab dkk., 2021)

## IV. RESULTS AND DISCUSSION

### **Potential and Problems**

At this stage, problem identification is carried out by distributing questionnaires to students. Based on the results of the questionnaire, 41.7% of students thought that chemical titration material was material that was difficult to understand because there was a lot of memorization and analysis. Teachers often use the question-and-answer learning method with a little practical work and use worksheets as a learning resource. Based on this, the researcher wants to develop a problem solving-oriented e-worksheet on acid-base titration material which includes virtual practicum.

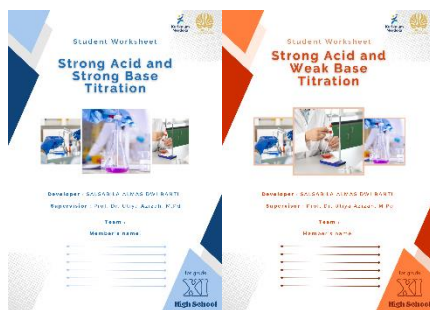
### **Data collection**

In this step, pre-research is carried out by giving students metacognitive skills tests. There are three components used in this metacognitive skills test, namely planning, monitoring and evaluating. In the planning component, only 41% of students can be said to be sufficiently trained. In the monitoring component, there are also 41% of students who can be said to be sufficiently trained. Meanwhile, in the evaluation component, only 36% of students trained their metacognitive skills.

### **Product Design**

The e-worksheet developed consists of a cover, table of contents, concept map, learning outcomes and learning objectives, problem solving learning steps, applications, and bibliography.

The problem solving steps are related to metacognitive skills, namely in steps (1) understanding the problem and (2) making a problem solving plan, the metacognitive skills are planning skills where the activities carried out are identifying to get information, thinking and writing down what what is known, in step (3) implementing the problem solving plan, the metacognitive skills are monitoring skills where the activities carried out are writing down important notes of information, solving problems, and in step (4) re-evaluating the results of the solution the metacognitive skills are evaluating skills where the activity carried out is to reflect on the learning strategies used and re-check students' understanding of the material. The following is the e-worksheet cover design that was developed.



**Figure 1.** Cover of E-worksheet Acid Base Titration

**Product Review and Revision**

Before the e-worksheet is given to the validator for validation, the e-worksheet developed has gone through a review process carried out by the supervisor and received approval.

**Product Validation**

The validity of the problem solving-oriented e-worksheet that was developed was obtained from the results of the validation sheet analysis based on the appropriateness aspects of content, presentation, language and graphics. Validity is obtained from the results of media validation carried out by 3 expert validators. The following is the mode acquisition for each aspect of validity.

**Table 5.** E-Worksheet Validity Results

Validity aspect	Modus	
	E-worksheet 1	E-worksheet 2
Eligibility of content	4	4
Language	4	4
Presentation	4	4
Graphics	4	4

Information:

E-worksheet 1 = Titration of Strong Acids and Strong Bases

E-worksheet 2 = Titration of Strong Acids and Weak Bases

Based on table 5, the results of the validity assessment in all aspects are declared valid because they have mode  $\geq 3$  (Lutfi, 2021). The results of the assessment on the feasibility aspect of the content received mode 4 for both e-worksheet with very good criteria. This is relevant to the results of the validity of the contents of the POGIL E-worksheet getting mode 4, so it is declared valid (Tyas & Novita, 2023).

In the linguistic aspect, the two e-worksheets got mode 4 with very good criteria. This is relevant to research conducted by Putri and Qosyim (2021), the LKPD developed in terms of language criteria received a score of 4 so it was said to be very valid (A. A. Putri & Qosyim, 2021).

In the presentation aspect, the two e-worksheets got mode 4 with very good criteria. This is relevant to research conducted by Nurkhalida & Nasrudin (2023), The student worksheet on acid-base material that was developed based on the construct validity of the presentation criteria received a mode  $\geq 3$  so it was declared valid (Nurkhalida & Nasrudin, 2023).

In the graphic aspect, mode 4 was obtained for both e-worksheet with very good criteria. This is relevant to research conducted by Nurkhalida & Nasrudin (2023), The student worksheet on acid base material developed on the construct validity of graphic criteria received a mode  $\geq 3$  so it was declared valid (Nurkhalida & Nasrudin, 2023).

**Product Revision**

At the validation stage, several suggestions for improvements were obtained by the validator, so that a revision of the e-worksheet developed before carrying out the product trial stage was carried out.

**Product Trial**

E-worksheet which has been validated by the validator and has been revised, is then tested. This product trial was carried out in class of 11 Science 13 at Senior High School for 3 meetings. This product trial aims to determine the practicality of e-worksheet based on student response questionnaires and the effectiveness of e-worksheet based on pretest and posttest of student metacognitive skills.

1. Practicality

Practicality is obtained from student response questionnaires. The following is a recapitulation of student responses

**Table 6.** Recapitulation of Student Response Questionnaires

Aspect	Percentage	Category
Contents	95,24%	Very Good
Language	88,095%	Very Good
Presentation	86,666%	Very Good
Graphics	88,095%	Very Good

Based on table 6, the results of the questionnaire recapitulation of student responses to the e-worksheet that were developed were obtained. According to previous research, the content aspect obtained a percentage of 93%, the linguistic aspect obtained a practicality of 100%, the presentation aspect obtained a practicality of 97%, and the graphic aspect obtained a practicality of 91%. So we get a total level of practicality of learning media of 95% in the very practical category (S. R. Putri & Sukarmin, 2023).

Based on the results of the analysis of student response questionnaires, all statements received a percentage of  $\geq 61\%$  in the very good category. The overall practicality level of the developed e-worksheet is 89.88%. It can be concluded that the e-worksheet developed is included in the very good category.

2. Effectiveness

The effectiveness of the e-worksheet being developed is assessed through the results of metacognitive skills tests. Students' metacognitive skills are measured by a test containing 4 descriptive questions where each question consists of three metacognitive skills, namely planning skills, monitoring skills, and evaluating skills. The following is the n-gain pretest and posttest score for metacognitive skills for each component.

**Table 7.** N-gain Metacognitive Skills

Skills	N-gain	Category
Planning Skills	0,72	High
Monitoring Skills	0,73	High
Evaluating Skills	0,71	High

Based on Table 7, there is an increase in each component of metacognitive skills in the high category. Planning skills got an n-gain of 0.72, monitoring skills got an n-gain of 0.73, and evaluating skills got an n-gain of 0.71. This is relevant to previous research with the title "Development of Student Worksheets Problem Solving Oriented to Metacognitive Skills Students Grade (Rizqiyah & Azizah, 2023).

Apart from using N-gain, pretest and posttest metacognitive skills scores were also analyzed using SPSS-assisted T-test

a. Normality test

The pretest and posttest data were tested for normality first to find out whether the two data were normally distributed or not. Normality test was carried out using the Kolmogorov Smirnov test with the help of SPSS 25. The following are the results of the metacognitive skills normality test.

**Table 8.** Metacognitive Skills Normality Test Results

		Unstandardized Residual
N		21
Normal Parameters <sup>a,b</sup>	Mean	.0000000
	Std. Deviation	7.05815418
Most Extreme Differences	Absolute	.149
	Positive	.149
	Negative	-.116
Test Statistic		.149
Asymp. Sig. (2-tailed)		.200 <sup>c,d</sup>

Based on the results of the normality test using Kolmogorov Smirnov, it shows that the normality test obtained a Sig value. (2-tailed) is  $0.200 > 0.05$ , so it can be concluded that both data are normally distributed (Wahab dkk., 2021). Next, a paired sample t-test will be carried out.

b. Uji Paired Sample T-Test

Berikut merupakan hasil uji *paired sample t-test* keterampilan metakognitif

**Table 9.** Paired Sample T-Test Results of Metacognitive Skills

t	df	Sig. (2-tailed)
-27.937	20	.000

Based on Table 9, the significance value is  $< 0.05$ , so  $H_0$  is rejected and  $H_1$  is accepted (Wahab dkk., 2021). This is in accordance with research Hanun & Azizah (2022), get the sig value. (2-tailed) 0.00 which indicates a significant difference in the pretest-posttest scores. So, it can be concluded that the pretest and posttest results of students on each component of metacognitive skills experience

significant differences so that metacognitive skills can be trained after learning using the problem solving-oriented e-worksheet that was developed.

## V. CONCLUSION

This development research has produced a product in the form of a problem solving-oriented e-worksheet to train students' metacognitive skills on acid-base titration material. Based on the results of the research and discussion, it can be concluded that the e-worksheet developed is declared suitable for use as teaching material in chemistry learning because it meets the following eligibility criteria:

1. The validity of the problem solving-oriented e-worksheet to train students' metacognitive skills in acid-base titration material is declared valid in terms of content criteria, getting mode 4 in e-worksheet 1 and e-worksheet 2. Meanwhile, the construct criteria get mode 4 in e-worksheet 1 and e-worksheet 2.
2. The practicality of problem solving-oriented e-worksheet to train students' metacognitive skills in acid base titration material is stated to be practical in terms of the average percentage of student responses of 89.88% with very practical criteria and supported by the results of observations of student activities by obtaining a percentage of relevant activities at meetings 1 and 2 of 95.55% respectively; and 95%.
3. The effectiveness of the problem solving-oriented e-worksheet for training students' metacognitive skills in acid-base titration material was stated to be effective in terms of the pretest and posttest scores, namely the metacognitive skills test. Overall, the N-gain score of the metacognitive skills test for each indicator, namely planning skills, monitoring skills and evaluating skills, was 0.72; 0.73; and 0.71 with high criteria. This is supported by the results of the paired sample t-test for metacognitive skills, which obtained a sig value. (2-tailed) of 0.000 which can be interpreted as meaning that there are differences in students' metacognitive abilities before and after using problem solving-oriented e-worksheet.

## REFERENCES

- [1] Apriliyani, S. W., & Mulyatna, F. (2021). Flipbook E-LKPD dengan Pendekatan Etnomatematika pada Materi Teorema Pythagoras. *Seminar Nasional Sains*, 2(1), 491–500.
- [2] Azizah, U., Mitarlis, & Herdyastuti, N. (2017). *Kimia Dasar I*. Unesa University Press.
- [3] Azizah, U., Nasrudin, H., & Mitarlis. (2019). Metacognitive Skills: A Solution in Chemistry Problem Solving. *Journal of Physics: Conference Series*, 1417(012084), 1–8. <https://doi.org/10.1088/1742-6596/1417/1/012084>
- [4] Azizah, U., & Nasrudin, H. (2021). Metacognitive Skills and Self-Regulated Learning in Prospective Chemistry Teachers: Role of Metacognitive Skill-Based Teaching Materials. *Journal of Turkish Science Education*, 18(3), 461–476. <https://doi.org/10.36681/tused.2021.84>
- [5] Azizah, U., & Nasrudin, H. (2022). Problem Solving Thinking Skills: Effectiveness of Problem-Solving Model in Teaching Chemistry College Students. *Jurnal Penelitian Pendidikan IPA*, 8(3), 1462–1469. <https://doi.org/10.29303/jppipa.v8i3.1700>
- [6] Farkhati, A., & Sumarti, S. S. (2019). Implementasi Manajemen Pembelajaran Kimia Berbantuan E-LKPD Terintegrasi Chemoentrepreneurship Untuk Menganalisis Soft Skill Siswa. *CiE (Chemistry in Education)*, 8(2), 1–5.
- [7] Fauzi, A., Rahmatis, A. N., Indraswati, D., & Sobri, M. (2021). Penggunaan Situs Liveworksheets untuk Mengembangkan LKPD Interaktif di Sekolah Dasar. *Mitra Mahajana: Jurnal Pengabdian Masyarakat*, 2(3), 232–240. <https://doi.org/10.37478/mahajana.v2i3.1277>
- [8] Hake, R. . (1999). *Analyzing Change/Gain Scores*. Measurement and Reasearch Methodology.
- [9] Hanun, L.D.T., Azizah, U. (2022); Application of Problem-Solving Learning Model Based Blended Learning to Improve Students Metacognitive Skills on Reaction Rate Material; International Journal of Scientific and Research Publications (IJSRP) 12(2) (ISSN: 2250-3153), DOI: <http://dx.doi.org/10.29322/IJSRP.12.02.2022.p12222>
- [10] Kemendikbud. (2022a). *Permendikbud No.33 Capaian Pembelajaran pada Pendidikan Anak Usia Dini, Jenjang Pendidikan Dasar, dan Jenjang Pendidikan Menengah Pada Kurikulum Merdeka*. Kemendikbud.
- [11] Kemendikbud. (2022b). *Permendikbud No.56 Pedoman Penerapan Kurikulum Dalam Rangka Pemulihan Pembelajaran*. Kemendikbud.
- [12] Kurniawati, E. E., Sumarti, S. S., Wijayati, N., & Nuswowati, M. (2021). Pengaruh Project Based Learning Berorientasi Chemoentrepreneurship Berbantuan E-Lkpd Terhadap Keterampilan Proses Sains Dan Sikap Wirausaha. *Chemistry in Education*, 10(1), 62–67. <http://journal.unnes.ac.id/sju/index.php/chemined>
- [13] Lathifah, M. F., Hidayati, B. N., & Zelandri. (2019). Pengintegrasian Potensi Lokal Pada Mata Kuliah Pendidikan Karakter Untuk Meningkatkan Hasil Belajar Dan Rasa Hormat Mahasiswa Terhadap Lingkungan. *Jurnal Pengabdian Magister Pendidikan IPA*, 4(1), 25–30. <https://doi.org/10.36312/jupe.v4i4.995>
- [14] Lutfi, A. (2021). *Research an Development (R&D) : Implikasi dalam pendidikan kimia*. Jurusan Kimia FMIPA UnIversitas Negeri Surabaya.
- [15] Murni, A. S., Tukan, M. B., & Boelan, E. G. (2021). Pengembangan Bahan Ajar Berbasis Lingkungan Pada Materi Asam dan Basa Siswa Kelas XI IPA 1 SMAK St. Familia Wae-Nakeng. *Jurnal Beta Kimia*, 1(1), 15–21.
- [16] Nopindra, C. T., & Soleh, S. M. (2019). Pengembangan Lembar Kerja Peserta Didik (E-LKPD) Berbasis Higher Order Thinking Skill (HOTS). *Indonesian Journal of Science and Mathematics Education*, 2(2), 168–176.

- [17] Nurkhalida, S., & Nasrudin, H. (2023). Development of Student Worksheet based Guided Inquiry to Train Students Critical Thinking Skills on Buffer Solution. *Jurnal Pendidikan Dan Pembelajaran Kimia*, 7(3), 423–430.
- [18] Petrucci, R. H., Herring, F. G., Madura, J. D., & Bissonnette, C. (2017). *General Chemistry: Principles and Modern Applications* (11th ed.). Pearson Canada Inc.
- [19] Pulmones, R. (2008). Learning Chemistry in a Metacognitive Environment. *The Asia-Pacific Education Researcher*, 16(2), 166–183. <https://doi.org/10.3860/taper.v16i2.258>
- [20] Putri, A. A., & Qosyim, A. (2021). Validitas perangkat pembelajaran saintifik 5M untuk meningkatkan keterampilan kolaborasi dan hasil belajar siswa SMP pada materi sistem pernapasan. *Pensa E-Jurnal: Pendidikan Sains*, 9(1), 7–16. <https://ejournal.unesa.ac.id/index.php/pensa/article/view/38484>
- [21] Putri, R. D. (2020). *Perbandingan Kekuatan Uji Metode Kolmogorov-Smirnov, Anderson-Darling, dan Shapiro-Wilk untuk Menguji Normalitas Data*. Sanata Dharma University.
- [22] Putri, S. R., & Sukarmin. (2023). Pengembangan E-Modul Berbasis Inkuiri Terbimbing untuk Melatihkan Keterampilan Berpikir Kritis Peserta Didik pada Materi Laju Reaksi. *PENDIPA Journal of Science Education*, 7(2), 327–335. <https://doi.org/10.33369/pendipa.7.2.327-335>
- [23] Redhana, I. W. (2019). Mengembangkan Keterampilan Abad Ke-21 Dalam Pembelajaran Kimia. *Jurnal Inovasi Pendidikan Kimia*, 13(1), 2239–2253.
- [24] Reed, S. K. (2000). *Cognition Fifth Edition*. Thomson Right.
- [25] Ristiyani, E., & Bahriah, E. S. (2016). Analisis Kesulitan Belajar Kimia Siswa Di SMAN X Kota Tangerang Selatan. *Jurnal Penelitian Dan Pembelajaran IPA*, 2(1), 18–29. <https://doi.org/10.30870/jppi.v2i1.431>
- [26] Rizqiyah, D. Z., & Azizah, U. (2023). Development of Student Worksheets Problem Solving Oriented to Train Metacognitive Skills Students Grade XI on Acid Base Materials. *Hydrogen Jurnal Pendidikan Kimia*, 11(August).
- [27] Slavin, R. E. (2010). *Cooperative Learning: Teori, Riset dan Praktik*, terj. Narulita Yusron. Bandung: Nusa Media.
- [28] Sugiyono. (2022). *Metode Penelitian Kuantitatif Kualitatif dan R&D*. Alfabeta.
- [29] Suhendri, H., & Mardalena, T. (2015). Pengaruh Metode Pembelajaran Problem Solving terhadap Hasil Belajar Matematika Ditinjau dari Kemandirian Belajar. *Formatif: Jurnal Ilmiah Pendidikan MIPA*, 3(2), 105–114. <https://doi.org/10.30998/formatif.v3i2.117>
- [30] Tyas, B. W., & Novita, D. (2023). POGIL (Process Oriented Guided Inquiry Learning) e-Worksheet to Improve Critical Thinking Skills on Reaction Rate Material. *PENDIPA Journal of Science Education*, 7(2), 224–231. <https://doi.org/10.33369/pendipa.7.2.224-231>
- [31] Wahab, A., Junaedi, J., & Azhar, M. (2021). Efektivitas Pembelajaran Statistika Pendidikan Menggunakan Uji Peningkatan N-Gain di PGMI. *Jurnal Basicedu*, 5(2), 1039–1045. <https://doi.org/10.31004/basicedu.v5i2.845>
- [32] Zahroh, D. A., & Yuliani, Y. (2021). Pengembangan e-LKPD Berbasis Literasi Sains untuk Melatihkan Keterampilan Berpikir Kritis Peserta Didik pada Materi Pertumbuhan dan Perkembangan. *Berkala Ilmiah Pendidikan Biologi (BioEdu)*, 10(3), 605–616. <https://doi.org/10.26740/bioedu.v10n3.p605-616>

#### AUTHORS

**First Author** – Salsabila Almas Dwi Ranti, Chemical Education, Universitas Negeri Surabaya, Indonesia, [salsabilaalmas09@gmail.com](mailto:salsabilaalmas09@gmail.com) .  
**Correspondence Author** – Utiya Azizah, [utiyaazizah@unesa.ac.id](mailto:utiyaazizah@unesa.ac.id) , +62 813-3065-9134.