Chemined 15 (1) (2026)

Chemistry in Education

https://journal.unnes.ac.id/journals/chemined

Development of Electronic Student Worksheet Based on Multiple Intelligence on Acid Base Material to Improve Students' Logical Mathematical and Interpersonal Intelligence

Eyza Alifia[1*)] and Sri Wardani[1]

[1]Department of Chemistry, Faculty of Mathematics and Natural Sciences, Universitas Negeri Semarang, Indonesia

ARTICLE INFO

Article history:
Received: August 2025
Approved: July 2026
Published: July 2026

Kata Kunci:
Lembar Kerja Siswa Elektronik; Interpersonal; Matematika Logis; Kecerdasan Ganda

Keywords:
Electronic Student Worksheets; Interpersonal; Logical Mathematical; Multiple Intelligence

DOI:
https://doi.org/10.15294/chemined.v15i1.32095

ABSTRAK

Penelitian ini bertujuan untuk mengetahui karakteristik, kelayakan, dan efektivitas Lembar Kerja Mahasiswa Elektronik berbasis Kecerdasan Ganda (E-WORKSHEET) pada materi asam-basa dalam meningkatkan kecerdasan logika-matematika dan interpersonal siswa. Metode penelitian yang digunakan adalah model pengembangan 4D, yang meliputi tahapan Define, Design, Develop, dan Disseminate. Instrumen yang digunakan dalam penelitian ini terdiri dari tes kecerdasan logis-matematis (pre-test dan post-test), lembar observasi kecerdasan interpersonal, dan kuesioner respon siswa. Data kecerdasan logika-matematis siswa dari pre-test dan post-test dianalisis menggunakan tes N-Gain, sedangkan peningkatan kecerdasan interpersonal dievaluasi melalui observasi yang dilakukan pada awal dan akhir proses pembelajaran. Pengujian kelayakan E-WORKSHEET oleh pakar konten dan pakar media masing-masing menghasilkan skor 98,76% dan 96,11%, keduanya dikategorikan sangat valid. Tes keterbacaan menghasilkan skor 86%, menunjukkan tingkat keterbacaan yang sangat baik. Analisis peningkatan kecerdasan logis-matematis menunjukkan skor N-Gain 0,60, dikategorikan sedang. Kecerdasan interpersonal siswa juga meningkat, dengan nilai rata-rata 76,29% pada kategori baik dan 82,73% pada kategori sangat baik. Berdasarkan temuan tersebut, dapat disimpulkan bahwa E-WORKSHEET berbasis Multiple Intelligence pada bahan asam-basa layak dan efektif dalam meningkatkan kecerdasan logika-matematika dan interpersonal siswa.

ABSTRACT

This study aims to determine the characteristics, feasibility, and effectiveness of a Multiple Intelligence-based Electronic Student Worksheet (E-WORKSHEET) on acid-base material in enhancing students' logical-mathematical and interpersonal intelligences. The research method employed is the 4D development model, which includes the stages of Define, Design, Develop, and Disseminate. The instruments used in this study comprise logical-mathematical intelligence tests (pre-test and post-test), interpersonal intelligence observation sheets, and student response questionnaires. Data on students' logical-mathematical intelligence from the pre-test and post-test were analyzed using the N-Gain test, while improvement in interpersonal intelligence was evaluated through observation conducted at the beginning and end of the learning process. Feasibility testing of the E-WORKSHEET by content experts and media experts yielded scores of 98.76% and 96.11%, respectively, both categorized as highly valid. The readability test resulted in a score of 86%, indicating a very good level of readability. The analysis of logical-mathematical intelligence improvement showed an N-Gain score of 0.60, categorized as moderate. Students' interpersonal intelligence also increased, with average scores of 76.29% in the good category and 82.73% in the very good category. Based on these findings, it can be concluded that the Multiple Intelligence-based E-WORKSHEET on acid-base material is feasible and effective in enhancing students' logical-mathematical and interpersonal intelligences.

*) **Correspondence address:**
Sekaran, Kec. Gunungpati, Kota Semarang
E-mail: eyzaalifia@students.unnes.ac.id

p-ISSN 2252-6609
e-ISSN 2502-6852

INTRODUCTION

Education aims to empower students'potential by providing a learning environment tailored to each learner's individual characteristics (Maulidiana, 2023). In addressing the challenges of the 21st century, students are required to master critical thinking, communication, collaboration, and creativity skills (Elitasari, 2022). To meet these demands, the government has undertaken continuous curriculum reform through the implementation of the Merdeka Curriculum, which offers educators the flexibility to adapt instructional strategies (Damayanti *et al.*, 2023). This curriculum emphasizes the development of students' soft skills and character through learner-centered approaches, supported by various instructional media such as modules, videos, PowerPoint presentations, and student worksheets (Nurafriani & Mulyawati, 2023).

Active student participation is a critical factor in achieving effective learning outcomes (Alfiqri & Indayani, 2022). Interview results indicate that student engagement in classroom activities remains suboptimal. The implementation of Discovery Learning involves five stages: stimulation, problem identification, data collection, verification, and conclusion. This model encourages students to construct knowledge independently, with the teacher serving as a facilitator. The advantages of Discovery Learning include enhanced autonomy, curiosity, and deeper conceptual understanding. However, it also presents certain limitations, such as extended learning time and disparities in students' prior knowledge (Azhar, 2024). Therefore, strategic efforts are needed to foster more effective active participation in order to improve overall learning quality. Chemistry instruction-particularly in acid-base topics -often poses challenges due to the abstract and complex nature of the concepts, such as dilution reactions, neutralization, and pH calculations (Utami *et al.*, 2020).

Based on interviews, students experience difficulties in solving problems that require logical reasoning and chemical calculations. Consequently, enhancing logical-mathematical intelligence has become a central focus in chemistry instruction, particularly through strategies that promote the development of logical and analytical thinking skills to improve conceptual understanding and accuracy in solving quantitative problems. Logical-mathematical intelligence, one of the eight multiple intelligences proposed by Gardner (1983), plays a crucial role in addressing calculation-based challenges in chemistry learning, especially in acid-base topics. Indicators of this intelligence include thinking patterns, logical analysis, problem solving, calculation processes, and mathematical operations (Lazear, 2004). This form of intelligence can be cultivated through chemistry instruction that demands mathematical and logical competencies, such as pH and ion concentration calculations (Utami *et al.*, 2020).

Each student possesses diverse forms of intelligence, such as logical-mathematical and interpersonal intelligence, which must be accommodated in the learning process (Sirate & Yaumi, 2022). The development of these intelligences can enhance students' skills and increase learning engagement. Teachers play a vital role in designing instructional methods that align with the characteristics of students'

intelligences (Berliana & Atikah, 2023). One approach to support this is through the use of Multiple Intelligence-based student worksheets (LKPD), which are designed to foster the development of students' intelligences throughout the learning process (Tri *et al.*, 2024). Rapid technological advancement has led to the emergence of interactive learning innovations, such as Multiple Intelligence-based electronic worksheets (E-WORKSHEET). Therefore, it is necessary to develop E-WORKSHEET integrated with the Problem-Based Learning (PBL) model. This model emphasizes solving real-world problems through group collaboration and active student participation, while also supporting the development of logical-mathematical and interpersonal intelligence in acid-base topics.

METHODS

This study employs a Research and Development (R&D) approach using the 4D model design-Define, Design, Develop, and Disseminate (Thiagarajan, 1974). The research aims to examine the characteristics, feasibility, and effectiveness of a Multiple Intelligence-based electronic worksheet (E-WORKSHEET) on acid-base material in enhancing students' logical-mathematical and interpersonal intelligence. The research subjects consisted of eleventh-grade students from SMA Negeri 8 Semarang, with class XI-3 serving as the experimental group and class XI-9 as the control group, each comprising 36 students. The sample was selected using purposive sampling. Data collection methods included interviews, logical-mathematical intelligence tests (pre-test and post-test), interpersonal intelligence observation sheets, student response questionnaires, and documentation. Logical-mathematical intelligence data were obtained through a descriptive test consisting of 10 items covering indicators from levels C2 to C4 of Bloom's Taxonomy. Interpersonal intelligence data were gathered using observation sheets developed based on established indicators of interpersonal intelligence. Observations were conducted by three observers at the beginning and end of the learning process. As supporting data, student response questionnaires were used to assess students' perceptions of the Multiple Intelligence-based E-WORKSHEET in acid-base instruction. The questionnaire employed a Likert scale and was administered to the experimental group after the learning activities concluded. Documentation included photographs taken during the learning process.

Feasibility analysis was derived from the validation results of the E-WORKSHEET conducted by expert validators. Meanwhile, the analysis of student responses was obtained through questionnaires administered during the readability test and large-scale trial. Data analysis was carried out using a descriptive quantitative approach, namely percentage-based assessment. The scoring guidelines for the expert validation sheet and response questionnaire employed a four-point Likert scale. The questionnaire data were analyzed using the following formula:

$$Va = \frac{Tse}{Tsh} \times 100\% \quad (1)$$

Description: Va = validity percentage

Tse = total empirical score obtained

Tsh = total maximum score

$$P = \frac{\Sigma Va}{n} \quad (2)$$

Description: P = average percentage of total validity

Vα = percentage of validity score from each validator

n = number of validators

(Rahayu *et al.,* 2021)

The percentage of validity from each validator was calculated using Equation 1. The resulting validity percentages were then categorized based on predetermined criteria. Table 1 presents the interpretation criteria for the validity of the Multiple Intelligence-based E-WORKSHEET product.

Table 1. Validity Criteria for the E-WORKSHEET

Score Range	Validity Criteria
80% < P ≤ 100%	Very Valid
60% < P ≤ 80%	Valid
40% < P ≤ 60%	Moderately Valid
20% < P ≤ 40%	Less Valid
0% < P ≤ 20%	Not Valid

Source: Ridwan (as cited in Eliza *et al.*, 2024)

RESULT AND DISCUSSION

Characteristics of the Multiple Intelligence-Based E-WORKSHEET

The developed E-WORKSHEET integrates the syntax of Problem-Based Learning (PBL) and includes learning activities that utilize Multiple Intelligences. There are two learning activities designed to engage six types of intelligence: (1) intrapersonal intelligence; (2) interpersonal intelligence; (3) logical mathematical intelligence; (4) linguistic intelligence; (5) bodily kinesthetic intelligence; (6) Naturalistic intelligence. The components of the E-WORKSHEET are as follows:

Figure 1. E-Worksheet Cover Page

Figure 2. Multiple Intelligence Content

Figure 3. Interpersonal Intelligence Approach

The material presented in the E-WORKSHEET focuses on the concept of acids and bases, encompassing fundamental understanding of acidic and basic properties, ion equilibrium in solution, pH calculations, acid-base indicators, and their applications in daily life. The content is systematically organized based on the learning outcomes and objectives outlined in the instructional module. The E-WORKSHEET consists of two main learning activities. The first activity emphasizes conceptual understanding of acids and bases, including pH calculations. The second activity involves a practical experiment using natural indicators. The learning media incorporated in the E-WORKSHEET utilize digital technology, such as flipbooks for interactive content delivery and Google Forms for student response submission and data storage. The visual design of the E-WORKSHEET was created using Canva, with font sizes adjusted to support readability: 27.5 pt for titles, 18 pt for subtitles, and 16 pt for body text.

The initial learning activities in the developed E-WORKSHEET focus on acid-base theory, ion equilibrium in acid-base solutions, and the calculation of acidity levels (pH) in such solutions. These activities are designed to engage four types of intelligence: (1) Interpersonal intelligence, students engage in group discussions, requiring effective communication and collaboration skills. This activity fosters the ability to interact, understand, and appreciate the perspectives and contributions of other group members. (2) Logical mathematical intelligence, students solve problems related to acid-base theory, ion equilibrium, and pH calculations. These tasks enhance logical-mathematical intelligence by encouraging students to analyze and perform calculations using the acid-base equations they have learned. (3) Linguistic intelligence, students complete paragraphs using a set of provided words. This task develops verbal-linguistic intelligence by prompting students to select appropriate vocabulary to construct coherent paragraphs that explain acid-base theory. (4) Intrapersonal Intelligence, students reflect on the material they have studied. This activity supports intrapersonal intelligence by encouraging self-assessment and personal insight into their understanding of the subject matter.

The second learning activity in the developed E-WORKSHEET involves students conducting an experiment using natural acid-base indicators. This activity integrates six types of intelligences: (1) Kinesthetic intelligence, students carry out the experiment by following the procedural steps in sequence and accurately recording the results. (2) Naturalistic intelligence, students utilize natural materials to demonstrate their ability to harness natural resources for scientific purposes. They document the color of natural indicator extracts, applying observational and classification skills based on color changes. Additionally, they explore their surroundings by examining the acidic and basic properties of various solutions-such as vinegar, lime juice, detergent solution, and dish soap-reflecting sensitivity to environmental and chemical components in everyday life. (3) Interpersonal intelligence, students collaborate in groups, engage in discussions, and demonstrate effective communication and information-sharing skills. They also show the ability to understand and respect differing viewpoints. (4) Logical

mathematical intelligence, students compile experimental data systematically and perform accurate data analysis. (5) Linguistic intelligence, students present their experimental findings to the class and participate in question-and-answer discussions with other groups. (6) Intrapersonal intelligence, students reflect on the material they have learned, fostering self-awareness and personal understanding of the concepts.

Feasibility of the E-WORKSHEET

The feasibility of the E-WORKSHEET was determined through a validation test conducted by three validators: a subject matter expert, a media expert, and a chemistry teacher. The validity of the E-WORKSHEET was assessed based on four aspects: content, presentation, language, and graphical design. The results of the validation analysis of the Multiple Intelligence-based E-WORKSHEET are presented in Table 2.

Table 2. Analysis of E-WORKSHEET Validation Results

Aspect	Percentage	Criteria
Content	99,30%	Highly valid
Presentation	98,95%	Highly valid
Language	97,61%	Highly valid
Graphical Design	95,51%	Highly valid

Content Aspect

The content aspect relates to the alignment with learning objectives, accuracy of the material, currency of the material, and suitability with students' needs.

Presentation Aspect

This aspect includes presentation techniques, presentation supports, and instructional presentation.

Language Aspect

The language aspect relates to clarity, communicative quality, dialogic and interactive nature, appropriateness with students' development, and conformity with language rules.

Graphical Design Aspect

Graphical feasibility relates to the size of the E-WORKSHEET, cover design, and internal design of the E-WORKSHEET.

Effectiveness of the E-WORKSHEET

The effectiveness of the E-WORKSHEET was evaluated based on observations of students' interpersonal intelligence and the results of pretest-posttest scores. Students' interpersonal intelligence was assessed through observation sheets completed at the beginning and end of the learning sessions. These observation sheets aimed to determine the level of interpersonal intelligence among students. The interpersonal intelligence observation sheet consisted of five indicators: empathetic processing, giving

feedback, listening to others, team building, inquiry and questioning. Each indicator was scored on a scale of 1 to 4. Interpersonal intelligence refers to the ability to understand and communicate effectively with others. Individuals with strong interpersonal intelligence excel in recognizing others' emotions, motivations, and desires, and in building positive social relationships. The results of students' interpersonal intelligence achievements in the experimental class are presented in Figure 4.

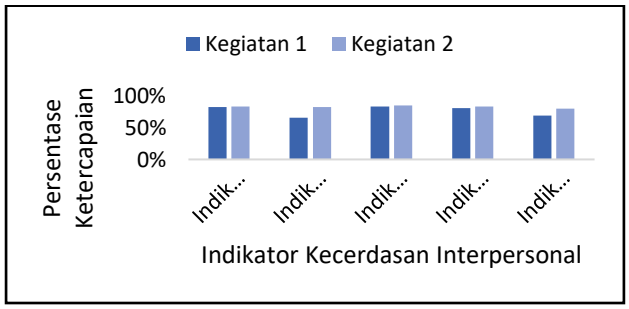

Figure 4. Percentage of Interpersonal Intelligence in the Experimental Class

Description:
Indicator 1: Empathetic processing
Indicator 2: Giving feedback
Indicator 3: Listening to others
Indicator 4: Team building
Indicator 5: Inquiry and questioning

Based on Figure 4, the order of percentage achievement for interpersonal intelligence indicators from highest to lowest in the first learning activity is as follows: listening to others, empathetic processing, team building, inquiry and questioning, and giving feedback. The percentage for each indicator is 83.10% for listening to others, 82.40% for empathetic processing, 80.78% for team building, 68.75% for inquiry and questioning, and 65.97% for giving feedback. In the second learning activity, the percentages were 85.18% for listening to others, 83.33% for empathetic processing, 83.10% for team building, 82.17% for giving feedback, and 79.86% for inquiry and questioning. From these five indicators, the average interpersonal intelligence score in class XI-3 was 76.23% during the first learning activity and 82.73% during the second. These scores fall into the "good" and "very good" categories. The observation results indicate that students' interpersonal intelligence improved with each session. The results of interpersonal intelligence achievement in the control class are presented in Figure 5.

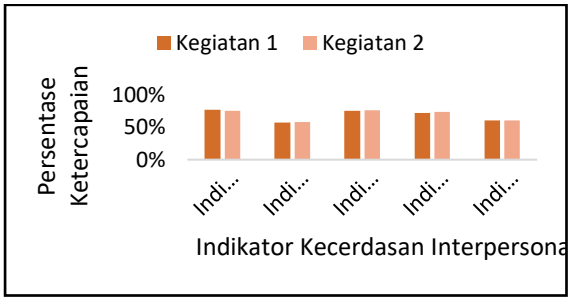

Figure 5. Percentage of Interpersonal Intelligence in the Control Class

Based on Figure 5, the order of percentage achievement for interpersonal intelligence indicators in the first learning activity, from highest to lowest, is as follows: empathetic processing, listening to others, team building, inquiry and questioning, and giving feedback. The percentage for each indicator is 77.08% for empathetic processing, 75.92% for listening to others, 72.68% for team building, 60.41% for inquiry and questioning, and 57.63% for giving feedback. In the second learning activity, the percentages were 75.92% for empathetic processing, 76.38% for listening to others, 73.84% for team building, 60.87% for inquiry and questioning, and 58.56% for giving feedback. From these five indicators, the average interpersonal intelligence score in class XI-9 was 68.70% during the first learning activity and 69.16% during the second. These achievement percentages fall into the "good" category.

Activities within the E-WORKSHEET, such as group tasks and collaborative reflection, promote active engagement among students. This improvement aligns with Gardner's (1983) theory of interpersonal intelligence, which refers to the ability to understand and interact effectively with others. The findings of this study also support previous research by Nurjanah et al. (2024), which stated that collaborative learning can enhance student engagement and motivation, strengthen social skills, and foster creative and innovative problem-solving. This indicates that the E-WORKSHEET is not merely a tool for individual learning, but also a medium that facilitates social interaction within the classroom learning context.

The improvement of logical-mathematical intelligence was quantitatively measured in the effectiveness test by comparing pre-test and post-test scores. Prior to the learning process, students were given a pre-test to assess their initial understanding of the subject matter. The learning activities were then conducted using a validated E-WORKSHEET, which had been revised based on feedback from validators and students. After completing the entire learning sequence, students took a post-test with a difficulty level equivalent to that of the pre-test. The learning objectives using the Multiple Intelligence-based E-WORKSHEET were not limited to mastering theoretical knowledge, but also aimed to develop analytical and mathematical skills-particularly in calculating pH, identifying acid-base compounds, and applying concepts to real-life contexts.

The research findings indicate that the use of Multiple Intelligences-based E-WORKSHEET has a positive impact on enhancing students' logical-mathematical intelligence. This is reflected in the n-gain score of the experimental class, which reached 0.60 (moderate category), higher than the control class with an n-gain of 0.40. The E-WORKSHEET, designed using a Multiple Intelligences approach, accommodates various types of student intelligences, particularly logical-mathematical, interpersonal, intrapersonal, naturalistic, kinesthetic, and linguistic intelligences. This approach enables students to access learning materials in alignment with their dominant intelligences, making the learning process more meaningful and effective. Research by Padilah et al. (2021) supports these findings, showing that Multiple Intelligences-based E-WORKSHEET is effective in improving students' communication skills and mathematical understanding. Furthermore, Wahyuni et al. (2024) demonstrated that LKPD developed with a Multiple Intelligences approach is highly valid and practical for mathematics instruction. This improvement suggests that digital media such as E-WORKSHEET can serve as a viable alternative for developing students' logical and mathematical abilities. Table 3 presents the N-Gain values for each indicator based on the processed data results.

Table 3. N-Gain of Logical-Mathematical Intelligence Indicators

Indicator	N-Gain	
	Experimental Class	Control Class
Thinking Patterns	0,89	0,63
Logical analysis	0,65	0,49
Problem solving	0,60	0,42
Calculation process	0,52	0,28
Mathematical operation	0,49	0,35

CONCLUSION

The feasibility of the Multiple Intelligences-based E-WORKSHEET was confirmed through expert validation in content and media, readability tests, and student response questionnaires. The respective percentages were 98.76% (content expert), 96.11% (media expert), 86% (readability), and 86.57% (student responses), indicating that the E-WORKSHEET is highly suitable for instructional use. Its effectiveness is demonstrated by the improvement in students' logical-mathematical intelligence scores, with an n-gain of 0.60 in the experimental class, categorized as moderate. Additionally, students' interpersonal intelligence was observed with an average percentage of 76.29% (good category) and 82.73% (very good category), showing meaningful development. These results affirm that the Multiple Intelligences-based E-WORKSHEET is not only feasible but also effective in enhancing both logical-mathematical and interpersonal intelligences.

REFERENCE

Alfiqri,Y., & Indayani, W. (2022). Penggunaan Model Pembelajaran *Two Stay Two Stray* untuk Meningkatkan Keaktifan Peserta Didik pada Pembelajaran Sejarah di Kelas XII MIPA 1 SMAN 2

Pekan baru. *Arus Jurnal Pendidikan*, 2(1), 34-39.

Azhar. (2024). Penerapan Model Discovery Learning dalam Mata Pelajaran SKI Untuk Meningkatkan Hasil Belajar Siswa MTsN 2 Aceh Besar. *Harmoni Pendidikan : Jurnal Ilmu Pendidikan*, *1*(2), 357–372.

Berliana, D., & Atikah, C. (2023). Teori Multiple Intelligences Dan Implikasinya Dalam Pembelajaran. *Jurnal Citra Pendidikan*, *3*(3), 1108–1117.

Damayanti, F., Vivien, H., Situmorang, M., Trianung, T., & Supadi. (2023). The problem of education in Indonesia is the independent curriculum the solution. *Scholar : Educational Scientific Journal Media*, *13*(5), 917–924.

Elitasari, H. T. (2022). Kontribusi Guru dalam Meningkatkan Kualitas Pendidikan Abad 21. *Jurnal Basicedu*, *6*(6), 9508–9516.

Eliza, Y.G., & Ain, S.Q. (2024). Pengembangan Media Jam Materi Mengenal Satuan Waktu pada Pembelajaran Matematika untuk Siswa Kelas II SDN 17 Pekanbaru. *Jurnal Kependidikan*, 13(1), 475-482.

Gardner, H. (1983). Frames of Mind: The Theory of Multiple Intelligences. New York: Basic Boooks.

Lazear. D.G. (2004). Higher-Order Thinking The Multiple Intelligences Way. Chicago: Zephir Press.

Maulidiana, S.F. (2023). Pengembangan Buku Aktivitas Belajar Survei Karakter untuk Mengetahui Ekosistem Karakter Siswa SD. Jurnal Pendidik Anak Cerdas dan Pintar, 7(1), 295-302.

Nurafriani, R.R, & Mulyawati, Y. (2023). Pengembangan E-WORKSHEET Berbasis Liveworksheet Pada Tema 1 Subtema 1 Pembelajaran 3. *Didaktik : Jurnal Ilmiah PGSD STKIP Subang*, 9(1), 404–414.

Nurjanah, Fitri, L., & Siti, R. K. (2024). *Budaya Pembelajaran Kolaboratif di Era Digital*. *Journal Educatione: Jurnal Manajemen Pendidikan,* 1(3), 25–34.

Padilah, R., Firmansyah, & Destini, R. (2021). Pengembangan LKPD Berbasis Multiple Intelligences untuk Meningkatkan Kemampuan Komunikasi Matematis Peserta Didik. *Jurnal Ilmiah Pendidikan Matematika AL-QALASADI*, 5(2), 133–140.

Rahayu, N. S., Cahyono, E., Susatyo, E. B, & Harjito. (2021). Pengembangan Lembar Kerja Peserta Didik Berbasis (Dbl) pada Materi Sistem Koloid. *Chemistry in Education*. 10(2), 70-77.

Sirate, S. F. S., & Yaumi, M. (2022). Pembelajaran Berbasis Multiple Intelligence: Konsep, Arah, dan Kecendunganya dalam Pendidikan Abad 21. *Prosiding Seminar Nasional,* 478-497.

Thiagarajan, S., Semmel, D. S., & Semmel, M. I. (1974). Instructional Development for Training Teachers of Exceptional Children. Minnesota: University of Minnesota.

Tri, A.D.P., Karundeng, M., & Lombok, J. Z. (2024). Pengembangan Media Perangkat LKPD (Lembar Kerja Peserta Didik) Berbasis Multiple Intellegence Pada Materi Laju Reaksi Di SMA Dian Harapan Holland Village. *General Chemistry Journal*, 1(2), 53-59.

Utami, F. V., Saputro, S., & Susanti, E.V.H. (2020). Analisis Jenis Dan Tingkat Kesulitan Belajar Siswa

Kelas XI MIPA SMA N 2 Surakarta Tahun Pelajaran 2018 / 2019 Dalam Memahami Materi Asam Basa Menggunakan Two Tier Multiple Choice. *Jurnal Pendidikan Kimia*, 9(1), 54–60.

Wahyuni, N., Yuberta, K. R., & Huda, U. (2024). Pengembangan Lembar Kerja Peserta Didik Berbasis Multiple Intelligences pada Materi Bangun Ruang Kelas VIII. *Journal of Mathematics Education and Applied*, 4(1), 52–64.