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Development of Teaching Materials to Support Merdeka Curriculum Learning on Basic Law of Chemistry Phase E

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Abstract

This research aims to develop teaching materials to support merdeka curriculum learning on the basic laws of chemistry phase E SMA / MA. This research uses the Educational Design Research (EDR) method using the Plomp development model as its research approach. The subjects of this study were three chemistry lecturers, two chemistry teachers and nine students with high, medium and low ability levels. Data were collected through the use of validation questionnaires and practicality questionnaires. The results showed that the teaching materials developed had an average validity of 0.89 which was included in the valid category. Furthermore, the results of the practicality test showed that students rated the teaching materials with an average practicality of 93%, which is classified as very practical. Similarly, teachers assessed the teaching materials with an average practicality of 95%, also considered very practical. Overall, the results of the study indicate that the development of teaching materials to support merdeka curriculum learning on basic chemical laws is valid and practical.

Keywords : teaching materials, merdeka curriculum, basic laws of chemistry

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INTRODUCTION

The impact of the Covid-19 pandemic has resulted in the world of education experiencing significant changes (Rozandy & Koten, 2021). The spread of Covid-19 has caused changes in the order of human life, including in the field of education (Khairunnisak et al., 2023). This change occurs in the Indonesian education system which has experienced a learning crisis, resulting in the emergence of learning loss (Rohimajaya et al., 2022). So that it has an impact on the learning process for students, teachers and parents or families of students (Hartandi & Mawardi, 2022). Various efforts have been made by the government in order to restore this situation, one of which is by giving freedom to each education unit to choose the curriculum that is applied at school (Rohimajaya et al., 2022). The government made a breakthrough to restore learning with the issuance of a policy on an merdeka curriculum (Rozandy & Koten, 2021).

The merdeka curriculum is a curriculum designed to make students more proficient in various aspects, such as independence, courage, politeness, and competence (Hasim, 2020; Pantiwati et al., 2023). The merdeka curriculum is anticipated to create a learning recuperation, encompassing three primary attributes such as project-based learning, soft skills and character development, learning with essential material and a more flexible curriculum structure (Jojor & Sihotang, 2022). In addition to developing an merdeka curriculum, the Ministry of Education and Culture also understands the new educational paradigm that is included in the 21st century learning concept (Faiz & Faridah, 2022). So that there are indicators of teacher readiness in

implementing 21st century learning, namely the teacher's need for alternative teaching materials, the application of character education and 21st century skills (Chotijah, H. Y., 2017). 21st century skills called 4C, namely creativity, communication, collaboration, and critical thinking (Fani & Mawardi, 2022).

Teaching materials are one of the important components to increase students' knowledge and experience in the learning process (Kokasih, 2021). Teaching materials contain material that is carefully arranged in accordance with teaching principles to achieve learning outcomes. In addition to containing material, teaching materials are also equipped with practice questions, summaries and discussion of questions that can help students to learn (Purwati & Erawati, 2021). Provided that the teaching materials align with the intended learning objectives, students can utilize them for their learning purposes (Piawi et al., 2018). Teaching materials serve multiple functions, including (1) facilitating the attainment of desired competencies in learning, (2) enhancing student learning outcomes, (3) contributing to improved student learning outcomes, and (4) assisting teachers in classroom management (Irham et al., 2017). In chemistry learning, the teaching materials used should contain multi-representations, in order to make it easier for students to understand concepts that are abstract. The use of multi-representation can be used to improve students' critical thinking skills (Rahmat et al., 2019).

In understanding chemical concepts, there are three levels of chemical representations consisting of macroscopic representations, submicroscopic representations, and symbolic representations that are interrelated (Farida et al., 2018). Representation at the macroscopic level can be seen by the five senses, such as changes in the form of matter, color, and temperature. Representation at the sub-microscopic level is describing the processes that occur at the particle level to explain macroscopic events. Symbolic representation is used to describe chemical processes expressed in the form of symbols, molecular formulas, numbers, and reaction equations (Safitri et al., 2019). Multi-representation in teaching materials to support merdeka curriculum learning is expected to build students' concept understanding more deeply in chemistry learning.

Chemistry learning in teaching materials to support phase E merdeka curriculum learning, one of which contains basic chemical law material. Basic chemical law material is material that is abstract and mathematical in nature. Basic chemical law material is material that must be learned by students as a basis for learning chemical calculations. In learning the basic laws of chemistry, students often have misconceptions that equate one law with another (Fajriani et al., 2019).

Based on observations made at SMAN 1 Padang, SMAN 8 Padang and SMA Pembangunan Labor UNP using interview techniques conducted to teachers, it was found that the availability of learning resources in the form of teaching materials that implement the merdeka curriculum is still limited. This is also supported by research conducted by (Angga et al., 2022) that the teaching materials for students who apply the independent curriculum are incomplete, only the guidebook for teachers is complete. Another opinion is in accordance with (Suryani, 2023) that the availability of teaching materials in accordance with the demands of the fact independent curriculum is still very limited. One of the materials available in teaching materials is the basic laws of chemistry. The material presented in the circulating merdeka curriculum teaching materials contains material content that is less detailed and less complete. Then the lack of multi-representation presentation on basic chemical law material. This is also in accordance with what was stated by (Rahmat et al., 2019) that the use of multi-representation can be used to improve students' critical thinking skills. Another opinion is in accordance with (Murni et al., 2022) that various multirepresentations of the material being studied can help learners in finding concepts. This is because the new merdeka curriculum will be implemented in the 2021/2022 academic year.

Along with the demands of technology, there is a need for innovation, ideas, and ideas in developing teaching materials to support merdeka curriculum learning with the hope of making it easier for teachers and students in the learning process. Previous research has conducted

research on the development of electronic teaching materials for 2013 curriculum on basic chemical laws with the results found that teaching materials are very feasible to use in learning (Andani & Yulian, 2018). However, the development of teaching materials for the merdeka curriculum on basic chemical laws has never been done before. Therefore, a research on the development of teaching materials equipped with material content which will later be used as a textbook to support merdeka curriculum learning is carried out. Based on this background, research was conducted with the aim of developing teaching materials equipped with material content and multi-representation which will later be used as teaching books to support merdeka curriculum learning. It is hoped that later this teaching material can help teachers and students in learning at school and become teaching materials to support merdeka curriculum learning on basic chemical laws in phase E SMA / MA.

METHOD

This study is classified as educational development research, specifically Educational Design Research (EDR), which employs the Plomp development model devised by Tjered Plomp. The development model encompasses three primary stages: preliminary research, development or prototyping phase, and assessment phase. (Plomp & Nieveen, 2013)(Alfidyah, M., & Mawardi, 2021).

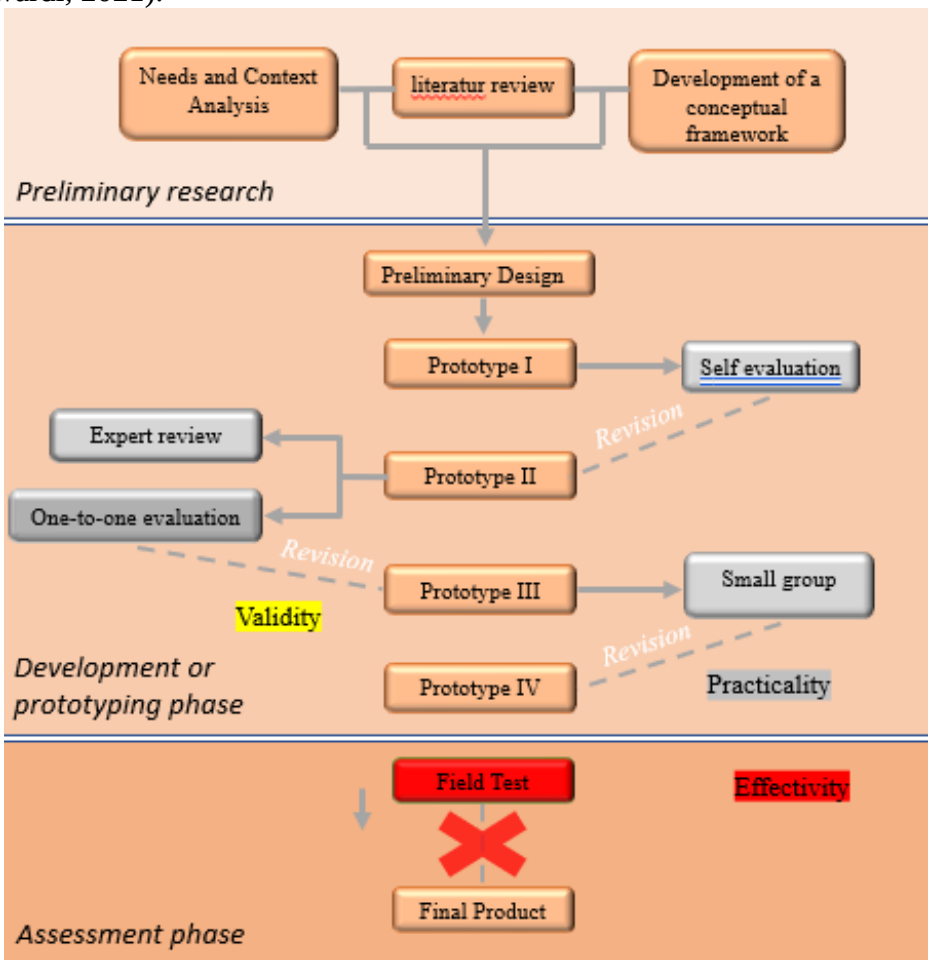


Figure 1. Stages of development of teaching materials to support learning of the merdeka curriculum on basic chemical law material

Based on Figure 1, this research is limited to the small group practicality test or until prototype IV is produced. The research will be conducted at SMAN 8 Padang. The research subjects in this study consisted of UNP chemistry lecturers, chemistry teachers, and phase E students of SMAN 8 Padang. During the initial research (preliminary) phase, an analysis of

needs and context, a review of relevant literature, and the development of a conceptual framework were carried out (Alfidyah, M., & Mawardi, 2021).

1) Needs and context analysis

The needs and context analysis stage was carried out by interviewing three chemistry teachers with the aim of knowing the obstacles experienced by teachers and students in the learning process of basic laws of chemistry in related schools.

2) Literatur review

The next stage is a literature review by collecting sources that are relevant to the research to be carried out (Syafei & Mawardi, 2022).

3) Development of a conceptual framework

Then a conceptual framework will be designed which will be used as the basis for designing teaching material development to support merdeka curriculum learning on basic chemical laws.

After conducting preliminary research, followed by the development or prototyping stage. researchers conducted analysis, design, evaluation, and revision of the products developed. There are four prototypes that will be produced through a series of formative evaluations, namely prototype I which is the initial design of the product, prototype II from the results of self-evaluation, prototype III revised results from validator evaluations (Material Experts) and one-to-one evaluations, and prototype IV which is the result of revisions from small groups (Siregar & Mawardi, 2022).

Data Collection Instrument

The instruments utilized for data collection in this research consist of validity measures and practicality measures. The validity instrument is a questionnaire sheet for the validity of teaching materials to support merdeka curriculum learning to evaluate the suitability or appropriateness of the content within the generated teaching materials. The practicality instrument is a response questionnaire given to teachers and students which aims to assess the teaching materials produced in terms of use, time efficiency and benefits so that the practicality of teaching materials to support merdeka curriculum learning can be known.

Data Analysis Techniques

The validity data analysis technique uses Aiken's V formula.

$$V = \frac{\sum S}{n\,(C-1)}$$

$$S = r - lo$$

Description :

S = the score set by the validator minus the lowest score in the score used

lo = low validity assessment score (in this case = 1)

c = highest validity assessment score (in this case = 5)

r = score authorized by a rater or validator

The criteria for the level of validity according to Aiken are in Table 1.

Table 1. Aiken Aiken's V

Index Aiken V	Validity category
V ≥ 0,80	Valid
V < 0,80	Invalid

(Aiken, 1985)

Meanwhile, the data analysis technique for practicality uses the following formula.

$$NP = \frac{R}{SM} \times 100$$

Description :
NP = Percentage of the sought or expected value
R = Raw score values obtained by learners
SM = The desired maximum score on the test in question
100 = Fixed number

The criteria for the level of practicality can be seen in Table 2.

Table 2. Practicality level conversion

Values	Assessed Aspect
86% - 100%	Very practical
76% - 85%	Quite practical
60% - 75%	Practical
55% - 59%	Less Practical
≤ 54%	Not practical

(Yuliawati & Meki, 2018)

RESULTS AND DISCUSSION

The results of this teaching material development research were carried out based on educational development procedures or Educational Design Research (EDR) using the Plomp development model developed by Tjered Plomp. The steps are preliminary research, development or prototyping phase and assessment phase (Plomp & Nieveen, 2013)(Alfidyah, M., & Mawardi, 2021).

Preliminary Research

The first stage, namely the preliminary research stage, a needs and context analysis, literature study, and development of a conceptual framework were carried out.(Alfidyah, M., & Mawardi, 2021). The first step taken was a needs and context analysis by interviewing three chemistry teachers in three different schools in Padang city. Based on the results of observations that have been made by researchers at SMAN 1 Padang, SMAN 8 Padang and SMA Pembangunan Labor UNP. In the needs analysis, it was found that the three schools had just used the merdeka curriculum for the first year. After being analyzed, it turned out that there were several significant changes from the previous curriculum, such as lesson plans (RPP) to teaching modules, basic competencies (KD) to learning outcomes (CP), Syllabus into ATP (Flow of Learning Objectives), material that was not sequential, there were Pancasila student profile activities (Novrita Suryani, 2019).

The next problem found is that the availability of learning resources in the form of teaching materials that implement the merdeka curriculum is still limited. So that students need many other references to increase knowledge and to better understand the material. One of the materials contained in the teaching materials is the basic laws of chemistry. The material presented in the circulating merdeka curriculum teaching materials contains material content that is less detailed and less complete. Some students still find it difficult to learn basic chemical law material, because students are still quite difficult to find their own concepts, it is still difficult to calculate, and it is difficult to determine compounds that fulfill these laws (Handayani, 2018).

Therefore, it is necessary to have multi-representation in order to help students in finding concepts. Concept formation can apply three types of representations, known as chemical multirepresentations, to express chemical ideas, so that the chemical learning process produces three learning levels, namely symbolic, macroscopic and sub-microscopic, or molecular representations, which are indispensable for students to understand chemistry (Mawardi &

Fitriza, 2019). However, it turns out that the merdeka curriculum teaching materials available at school still lack multi-representation presentations and only contain a lot of writing and the use of language which makes it a little difficult for students to understand the material. In the context analysis, the basic laws of chemistry contained in the merdeka curriculum teaching materials are in the form of the law of conservation of mass (Lavoiser's law), the law of permanent comparison (Proust's law), the law of multiple comparisons (Dalton's law), the law of volume comparison (gay-lussac's law), Avogadro's hypothesis, relative atomic mass, relative molecular mass, and the mole concept.

The next step is literature review by collecting relevant sources in previous research, namely, research conducted by (Sartika & Yusmaita, 2020), the results showed that "the content validity value of the designed chemical literacy assessment is categorized as "valid" with a value of 1.11. In 15 items of questions, there are 3 questions with a very significant category, 9 questions with a significant category and 3 questions with an insignificant category. Furthermore, research conducted by (Mardani & Azra, 2020), the results of the media validity test have a kappa moment (k) with a high category of 0.78. For the results of the practicality test, the media kappa moment (k) of 0.78 is included in the high category. Thus the chemmon game is said to be valid and practical as a chemistry learning media to learn "basic laws of chemistry". Furthermore, research conducted by (Chairi et al., 2016), the results showed a discovery learning-based Student Activity Sheet (LKS) product for basic chemical law material that had been tested for validity and practicality. The resulting LKS has an average value of 0.90 with a very high validity category, the average teacher practicality is 0.85 with a very high practicality category and the average student practicality is 0.72 with a high practicality category.

Furthermore, research conducted by (Talitha Salsabila Kinayung Fajri, 2023), the results of product quality assessment by material experts get an idealized percentage of 94.44% in the Very Good (SB) category, assessment by media experts gets an idealized percentage of 91.67% in the Very Good (SB) category, assessment by SMA / MA chemistry educators gets an idealized percentage of 90.83% in the Very Good (SB) category and student responses get an idealized percentage of 94.167%. So it can be concluded that the Multiple Representation-based LKPD learning media on basic chemical law material is very feasible to use.

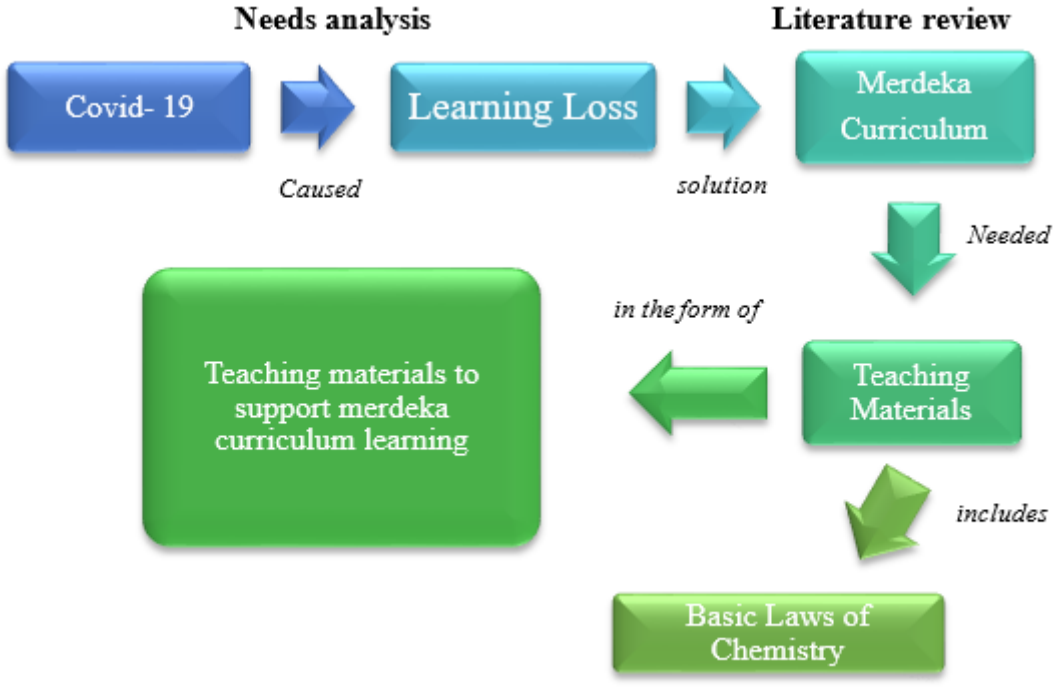


Figure 2. Conceptual Framework

The stages of developing a conceptual framework, based on Figure 2, can be explained that, at the preliminary research stage, needs analysis is carried out where the results are found that the Covid-19 caused Indonesian education system has experienced a learning crisis so that learning loss appears. To get a solution to this problem, a literature review was carried out so that a solution to the problem was obtained with the implementation of the merdeka curriculum. In order for the merdeka curriculum to be carried out properly needed one of them is teaching material that includes basic chemical law material. Therefore, teaching materials are needed in the form of teaching materials to support learning the merdeka curriculum.

Development or Prototyping Stage

Furthermore, at this stage four stages are carried out, namely self evaluation, expert review, one-to-one evaluation, and small group. thus producing prototype I, prototype II, prototype III, and prototype IV stages in the form of results from formative evaluation.

Prototype I

Researchers design teaching materials based on learning outcomes in accordance with the components of teaching materials to support learning the merdeka curriculum. The material component is equipped with a teaching material cover, preface, table of contents, learning outcomes (CP), learning objectives (TP), concept map, instructions for using the book, material content, profil pelajar pancasila, keywords, activities , sample questions, and discussions, comprehension tests for each meeting, end-of-book exercises, summary, reflection, bibliography, glossary, index, and answer key. The following are some of the components contained in the developed teaching materials.

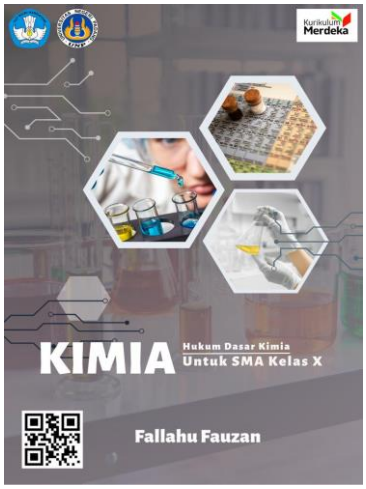


Figure 3. Cover of teaching

Figure 4. Instructions for use of teaching materials

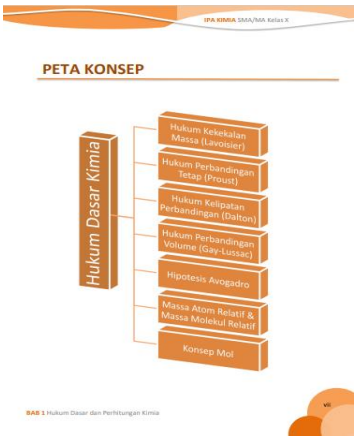


Figure 5. Concept maps

Figure 6. Table of content

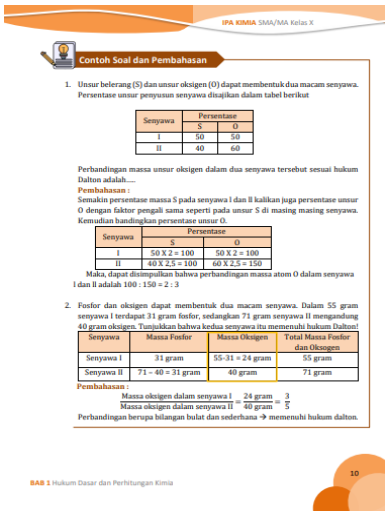


Figure 7. Examples and discussion

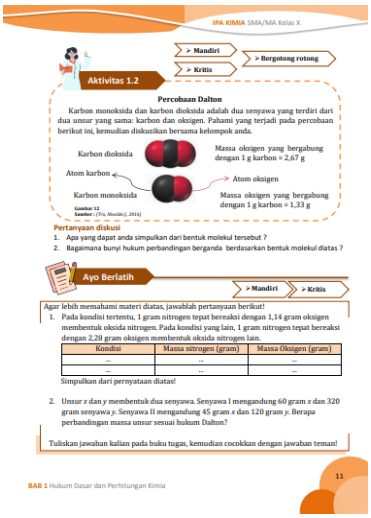


Figure 8. Activities and comprehension test

Prototype II

After prototype I is produced. then it will be formatively evaluated by conducting a self-evaluation of prototype I. At this stage of self-evaluation, researchers correct and review the completeness of the components of teaching materials to support the learning of the merdeka curriculum on the material of the basic laws of chemistry with an instrument in the form of a checklist questionnaire and then revise and complete the incomplete components or parts if there are incomplete. Based on the results of the self-evaluation that has been carried out by filling out a self-evaluation questionnaire, the components or parts of the teaching materials to support the learning of the merdeka curriculum developed are complete, so no revision is needed in prototype I.

Prototype III

Prototype III was derived through formative evaluation, which involved expert review and one-on-one evaluation of prototype II. In this case, experts act as validators who assess prototype II through an evaluation questionnaire given in the form of a content validity questionnaire. The review by experts aims to determine the level of validity related to content, presentation, language, and graphics. After the data is processed, the results of the content validity analysis can be seen in figure 15. Furthermore, one-to-one evaluation was carried out by interviewing three students with different ability levels to obtain valid teaching material results. The following are the components suggested by the experts to be revised again.

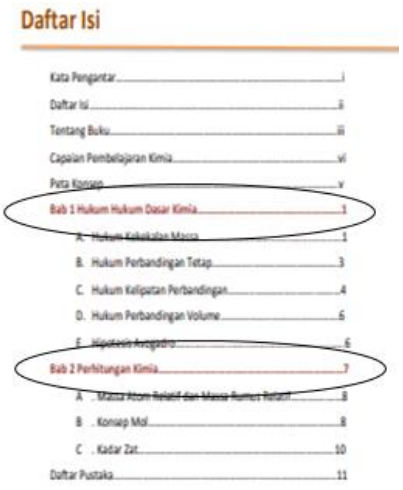


Figure 9. Before revision

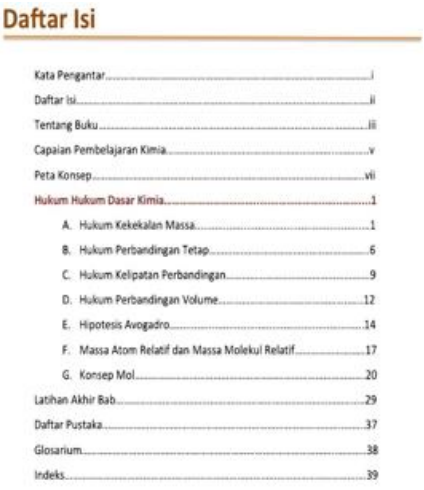


Figure 10. After revision

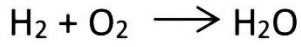


Figure 11. Before revision

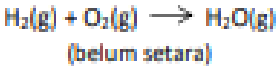


Figure 12. After revision

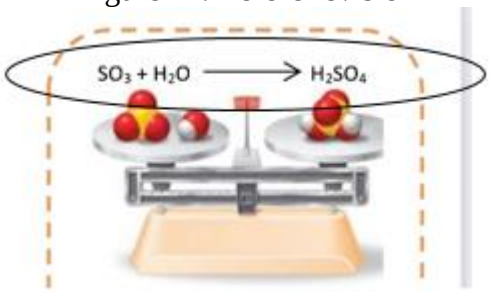


Figure 13. Before revision

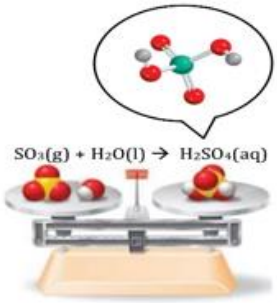


Figure 14. After revision

The first component that was revised was the table of contents, which previously contained two chapters of material then the validator gave suggestions that the material be made into one main title which was divided into several sub-materials. Then in figures 11 to 14 there is no phase in the reaction equation and the validator gives advice to add a phase to the reaction equation contained in the teaching material. Based on the results of the questionnaire assessment of five validators consisting of three UNP chemistry lecturers and two SMAN 8 Padang chemistry teachers against the product, the average value of the Aikens V index is 0.88 which can be seen in figure 15. Based on table 1, content validation is included in the valid category. Thus the teaching materials developed can be declared valid.

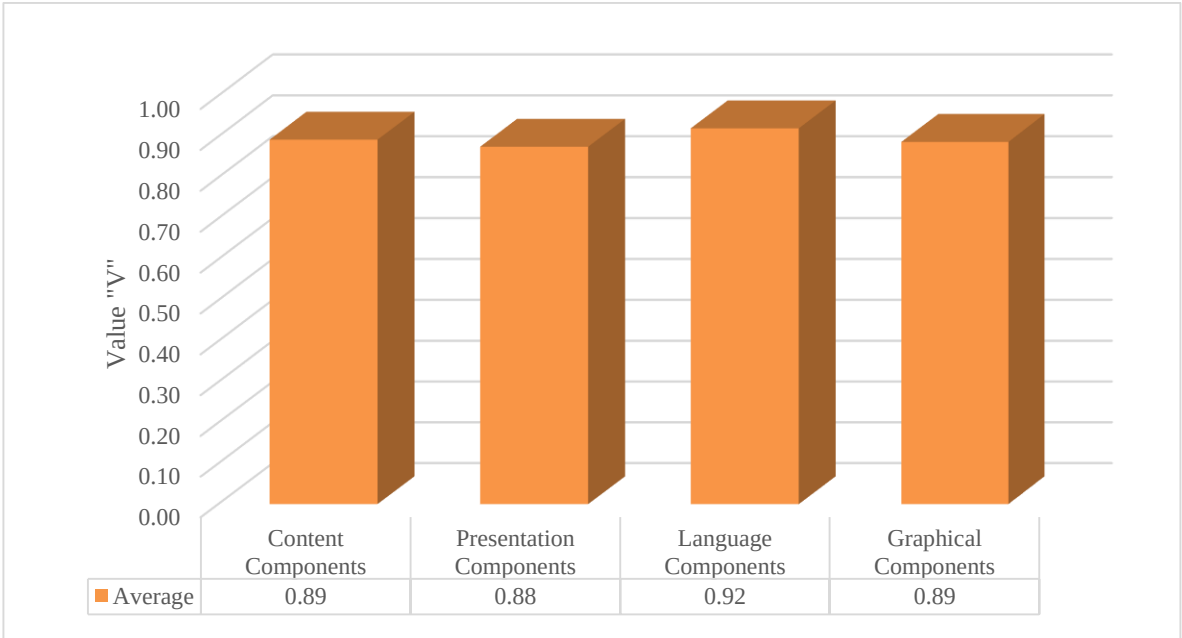
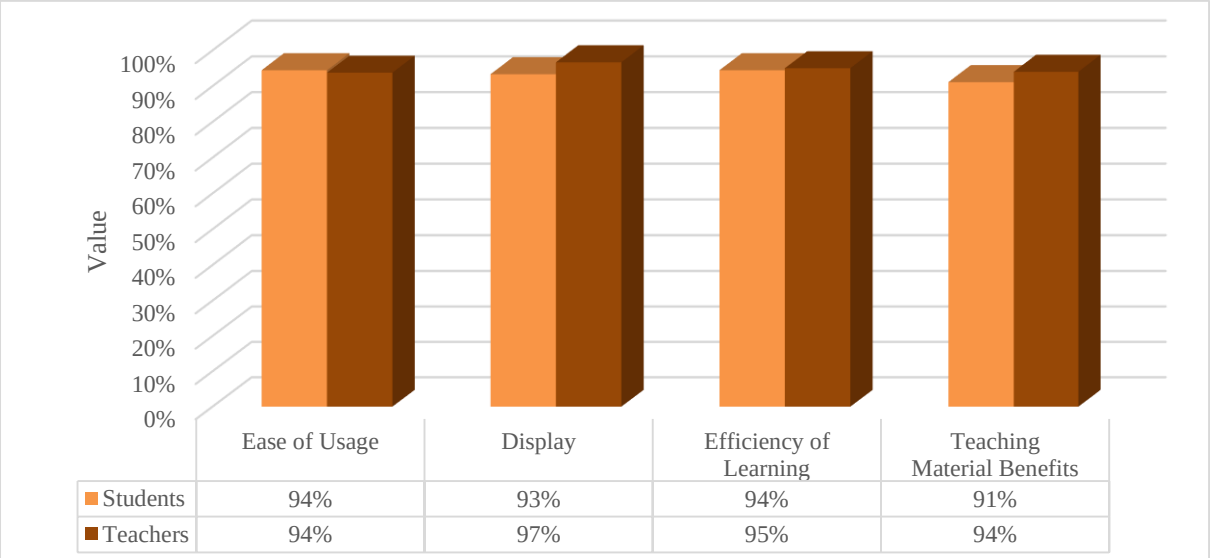


Figure 15. Content validation results

Prototipe IV

The valid teaching material products were then tested in small groups. The objects used at this stage were nine phase E students and two chemistry teachers of SMAN 8 Padang. Based on figure 16, the average percentage of small group practicality test results conducted on students is 91%. While the average percentage of small group practicality test results conducted on teachers is 94%. Based on table 2, the practicality test conducted on teachers and students was considered very practical. Assessment of the practicality test of teachers and students based

on aspects of ease of use, appearance, learning efficiency, and benefits in the teaching materials used is easy to understand. The content of the material and some of the representations displayed can guide students towards discovering and comprehending the concepts of the basic laws of chemistry. Thus the teaching materials developed are declared practical. The inclusion of sample problems along with discussions and practice questions in each learning activity can facilitate the development of students' critical thinking skills and foster independent learning skills.



	Ease of Usage	Display	Efficiency of Learning	Teaching Material Benefits
Students	94%	93%	94%	91%
Teachers	94%	97%	95%	94%

Figure 16. Small-group pratical results

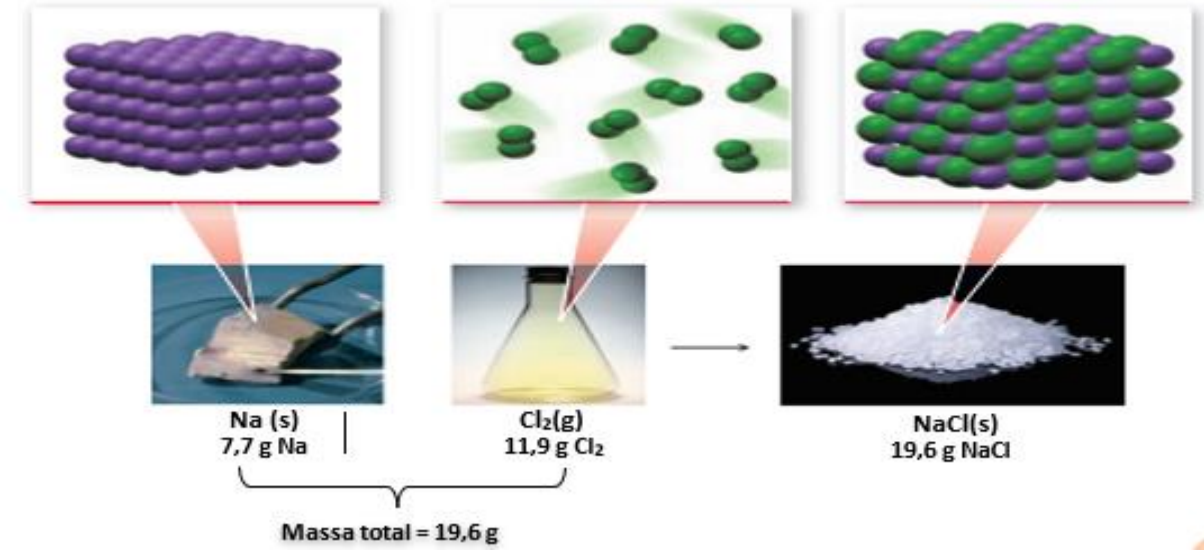


Figure 17. Multi-representation model in teaching materials

One of the exercise questions models that students must answer can be seen in figure 17. Here students are relied upon to know the concept of the law of conservation of mass. From the results of interviews conducted with students, it is known that the concept of the law of conservation of mass is "the mass of elements before and after the reaction is fixed" (Nivaldo J. Tro, 2016). So it can be seen in the figure that figure 17 is in accordance with the concept of the law of conservation of mass because the mass of the element before and after the reaction is fixed. During this phase, students are relied upon to answer the exercise questions accurately. The purpose of this stage is to explore the students' reactions and responses to the developed

learning materials. Based on the results of this stage, it is found that the appearance of the images in the teaching materials is very clear and interesting, making it easier for students to understand the material in the teaching materials and the language used is easy to understand, the instructions and questions given are very clear, making it easier for students to find concepts and answer the questions given, the use of teaching materials is not an obstacle for students in carrying out learning.

CONCLUSION

The results showed that teaching materials that had been tested for content validation obtained an average of 0.89 with a valid category and teaching materials that had been tested for practicality obtained an average of 93% with a very practical category and the average practicality conducted on teachers obtained an average of 95% with a very practical category. Overall, the results of this development research indicate that the development of teaching materials for the Merdeka Curriculum learning menu on the material of the basic laws of chemistry is valid and practical.

RECOMMENDATION

This research is expected to be continued to test its effectiveness on a wider scale so that this teaching material can be used by teachers and students during class learning. Teachers must be able to condition the class during learning. Meanwhile, students are expected to use teaching materials properly so that they can understand learning well in order to create active and interactive learning so that in the end the learning outcomes obtained are also high.

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This developmental research project relies on the assistance of various individuals, both directly and indirectly. Therefore, the researcher would like to extend gratitude to the following parties, Mr. Prof. Dr. Mawardi, M.Si as the supervising lecturer, Mrs. Prof. Dr. Minda Azhar, M.Si (final project examiner), Mrs. Okta Suryani, M.Sc, Ph.D (final project examiner and content validators), Mr. Prof. Dr. Rahadian Z, S.Pd., M.Si, and Mr. Dr. Riga, S.Pd., M.Si, content validators, Mrs. Dra. Asra, M.Pd and Mrs. Elvi Yanti, S.Pd, as chemistry teachers and content validators, Mr. Zahroni, M.Pd as Principal of SMA Negeri 8 Padang, has given research permission to researchers, phase E students of SMA Negeri 8 Padang for helping the researcher carry out the research.

REFERENCES

Aiken, L. R. (1985). Three coefficients for analyzing the reliability and validity of ratings, Educational and Psychological Measurument. *Journal Articles; Reports - Research; Numerical/Quantitative Data*, *45*(1), 131–142.

Alfidyah, M., & Mawardi, M. (2021). Development Of A Flipped Classroom Learning System Based On Guided Inquiry On Electrolyte And Non-Electrolyte Solution Materials. *Journal of Educational Sciences*, *5*(1), 66–79.

Andani, D. T., & Yulian, M. (2018). Pengembangan Bahan Ajar Electronic Book Menggunakan Software Kvisoft Flipbook Pada Materi Hukum Dasar Kimia di SMA Negeri 1 Panton Reu Aceh Barat. *Jurnal IPA & Pembelajaran IPA*, *2*(1), 1–6. https://doi.org/10.24815/jipi.v2i1.10730

Angga, A., Suryana, C., Nurwahidah, I., Hernawan, A. H., & Prihantini, P. (2022). Komparasi Implementasi Kurikulum 2013 dan Kurikulum Merdeka di Sekolah Dasar Kabupaten Garut. *Jurnal Basicedu*, *6*(4), 5877–5889. https://doi.org/10.31004/basicedu.v6i4.3149

Chairi, I., Ellizar, & Zainul, R. (2016). Pengembangan LKS dengan Pendekatan Saintifik Berbasis Discovery Learning Pada Materi Hukum Dasar Kimia untuk Pembelajaran Kelas X SMA/MA. *INA-Rxiv*, 1–7.

Chotijah, H. Y., & S. (2017). *Analisis Kebutuhan Pengembangan Buku Panduan Guru Implrmrntasi Lesson Study pada Pembelajaran Matematika Sekolah Dasar*.

Faiz, A., & Faridah, F. (2022). Program Guru Penggerak Sebagai Sumber Belajar. *Konstruktivisme : Jurnal Pendidikan Dan Pembelajaran*, *14*(1), 82–88. https://doi.org/10.35457/konstruk.v14i1.1876

Fajriani, G. N., Sopandi, W., & Kadarohman, A. (2019). Miskonsepsi Siswa Yang Menggunakan Teks Perubahan Konseptual Mengenai Hukum-Hukum Dasar Kimia. *Orbital: Jurnal Pendidikan Kimia*, *3*(1), 30–41. https://doi.org/10.19109/ojpk.v3i1.3361

Fani, V. G., & Mawardi, M. (2022). Flipped classroom learning system based on guided inquiry using moodle on acid-base solutions. *Jurnal Pijar Mipa*, *17*(3), 361–368. https://doi.org/10.29303/jpm.v17i3.3476

Farida, I., Helsy, I., Fitriani, I., & Ramdhani, M. A. (2018). Learning Material of Chemistry in High School Using Multiple Representations. *IOP Conference Series: Materials Science and Engineering*, *288*(1). https://doi.org/10.1088/1757-899X/288/1/012078

Handayani, D. P. (2018). *Pengembangan Multimedia Prezi Berbasis Problem Based Learning (PBL) pada Materi Hukum-Hukum Dasar Kimia Kelas X IPA di SMAN 1 Bukittinggi*. 2018.

Hartandi, M., & Mawardi, M. (2022). Effectiveness of The Guided Inquiry-Based Flipped Classroom Learning System on Buffer Solution Materials on Students' Learning Outcomes. *JKPK (Jurnal Kimia Dan Pendidikan Kimia)*, *7*(2), 194. https://doi.org/10.20961/jkpk.v7i2.63618

Hasim, E. (2020). Penerapan Kurikulum Merdeka Belajar Perguruan Tinggi Di Masa Pandemi Covid-19. *Prosiding Webinar Magister Pendidikan Dasar Pascasarjana Universitas Negeri Gorontalo "Pengembangan Profesionalisme Guru Melalui Penulisan Karya Ilmiah Menuju Anak Merdeka Belajar,"* 68–74.

Irham, S. M., Mr., M., & Oktavia, B. (2017). *The Development of Guided Inquiry-based Worksheet on Colligative Properties of Solution for Chemistry Learning*. *57*(ICMSEd 2016), 38–42. https://doi.org/10.2991/icmsed-16.2017.9

Jojor, A., & Sihotang, H. (2022). Analisis Kurikulum Merdeka dalam Mengatasi Learning Loss di Masa Pandemi Covid-19 (Analisis Studi Kasus Kebijakan Pendidikan) Anita. *Edukatif : Jurnal Ilmu Pendidikan*, *4*(4), 5150–5161. https://doi.org/10.31004/edukatif.v4i4.3106

Khairunnisak, I., Mawardi, M., Widarti, H. R., & Yamtinah, S. (2023). *Effectiveness of Guided Inquiry Based Student Worksheet Integrated with Flipped Classroom System on Reaction Rate Material on Students ' Ability to Think Critically*. *9*(5), 2431–2437. https://doi.org/10.29303/jppipa.v9i5.3271

Kokasih. (2021). *Pengembangan Bahan Ajar*. Bumi AKSARA.

Mardani, M. A., & Azra, F. (2020). Pengembangan Permainan Chemistry Backgammon (Chemmon) sebagai media pembelajaran kimia pada materi hukum-hukum dasar kimia kelas X SMA/MA. *Entalpi Pendidikan Kimia*, *1*(1), 93–101. https://doi.org/10.24036/epk.v1i1.16

Mawardi, M., & Fitriza, Z. (2019). The Guided Inquiry Learning Materials Based on Multiple Chemical Representations As One of Chemistry Learning Strategies Centered on Students. *Pelita Eksakta*, *2*(2), 140. https://doi.org/10.24036/pelitaeksakta/vol2-iss2/55

Murni, H. P., Azhar, M., Ellizar, E., Nizar, U. K., & Guspatni, G. (2022). Three Levels of Chemical Representation-Integrated and Structured Inquiry-Based Reaction Rate Module: Its Effect on Students' Mental Models. *Journal of Turkish Science Education*, *19*(3), 758–772. https://doi.org/10.36681/tused.2022.148

Nivaldo J. Tro. (2016). PRINCIPLES OF CHEMISTRY A MOLECULAR APPROACH. In *Applied Catalysis B: Environmental* (Vol. 206).

Novrita Suryani. (2019). Implementasi Kurikulum Merdeka Belajar di Sekolah Penggerak Novrita. *Jurnal Ilmiah*, *10*(2), 1–94. https://doi.org/10.33087/jiubj.v23i1.3291

Pantiwati, Y., Chamisijatin, L., Zaenab, S., & Aldya, R. F. (2023). Characteristics of Learning Assessment Towards Implementation of Merdeka Learning Curriculum. *Jurnal Penelitian Dan Pengkajian Ilmu Pendidikan: E-Saintika*, *7*(1), 115–128. https://doi.org/10.36312/esaintika.v7i1.1125

Piawi, K., Kalmar Nizar, U., & Mawardi, M. (2018). *Development of student worksheet based on guided inquiry with class activity and laboratory in thermochemistry material*. 679–683. https://doi.org/10.29210/20181100

Plomp, T., & Nieveen, N. (2013). An Introduction to Educational Design Research. In *Educational Design Research*.

Purwati, N. K. R., & Erawati, N. K. (2021). Pengembangan Buku Ajar Metode Numerik Berbasis Pembelajaran Kolaboratif. *Mosharafa: Jurnal Pendidikan Matematika*, *10*(1), 37–48. https://doi.org/10.31980/mosharafa.v10i1.817

Rahmat, R., Suwarma, I. R., & Imansyah, H. (2019). *Penerapan Model Pembelajaran Problem Based Learning Berbasis Multirepresentasi Untuk Meningkatkan Kemampuan Berpikir Kritis Siswa Sma Pada Materi Getaran Harmonik*. *VIII*, SNF2019-PE-101–106. https://doi.org/10.21009/03.snf2019.01.pe.13

Rohimajaya, N. A., Hartono, R., Yuliasri, I., & Fitriati, W. (2022). Kurikulum 2013 dan Kurikulum Merdeka dalam Perkembangan Bahasa Inggris untuk SMA di Era Digital: Sebuah Analisis Konten. *Prosiding Seminar Nasional Pascasarjana*, 825–829.

Rozandy, M. P. N., & Koten, Y. P. (2021). SCRATCH SEBAGAI PROBLEM SOLVING COMPUTATIONAL THINKING DALAM KURIKULUM PROTOTIPE. *Jurnal IN CREATE*, *8*, 11–17.

Safitri, N. C., Nursaadah, E., & Wijayanti, I. E. (2019). Analisis Multipel Representasi Kimia Siswa pada Konsep Laju Reaksi. *EduChemia (Jurnal Kimia Dan Pendidikan)*, *4*(1), 1. https://doi.org/10.30870/educhemia.v4i1.5023

Sartika, A. Y. M., & Yusmaita, E. (2020). Pengembangan Asesmen Literasi Kimia pada Materi Hukum-Hukum Dasar Kimia dan Stoikiometri Kelas X SMA/MA. *Edukimia*, *2*(3), 128–133. https://doi.org/10.24036/ekj.v2.i3.a187

Siregar, F. R., & Mawardi, M. (2022). Development of the Learning System of Flipped-Guided Inquiry-Based Learning (FGIL) Using Moodle on Chemical Equilibrium material. *Indonesian Journal of Educational Studies*, *25*(1), 31–49.

Suryani, O. (2023). PELATIHAN PENGEMBANGAN BAHAN AJAR MENGINTEGRASIKAN PRAKTIKUM DAN MULTIPELREPRESENTASI KIMIA DALAM PEMBELAJARAN BERBASIS MASALAH BAGI GURU KIMIA KOTA PADANG. *Fondatia Jurnal Pendidikan Dasar*, *7*, 514–527.

Syafei, S. S., & Mawardi, M. (2022). POGIL Model Integrated Flipped Classroom Assisted Learning Management System (LMS) for Learning Solution in ERI 4.0. *Jurnal Penelitian Pendidikan IPA*, *8*(2), 444–451. https://doi.org/10.29303/jppipa.v8i2.1298

Talitha Salsabila Kinayung Fajri, L. N. M. (2023). Pengembangan Lembar Kerja Peserta Didik (LKPD) Berbasis Multiple Representasi Pada Materi Hukum Dasar Kimia Kelas X SMA/MA Kurikulum Merdeka. *AR-RAZI Jurnal Ilmiah*, *7*(1), 705–714. https://doi.org/10.29406/ar-r.v7i1.1380

Yuliawati, Y., & Meki. (2018). Perancangan dan Pembuatan Media Pembelajaran Berbasis Android pada Mata Pelajaran Sistem Komputer. *Jurnal Pti (Pendidikan Dan Teknologi Informasi) Fakultas Keguruan Ilmu Pendidikan Universita Putra Indonesia "Yptk" Padang*, *5*(2), 31–41. https://doi.org/10.35134/jpti.v5i2.11