Journal of Educational Sciences
Journal homepage: https://jes.ejournal.unri.ac.id/index.php/JES

P-ISSN 2581-1657
E-ISSN 2581-2203

Development of Chemistry Teaching Materials with Demonstration Videos on the Acid–Base Concept to Support the Merdeka Curriculum

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ARTICLE INFO

Article history:

Received: 21 May 2025
Revised: 10 June 2025
Accepted: 11 June 2025
Published online: 05 July 2025

Keywords:

Acid–Base,
Curriculum,
Demonstration,
Teaching, Video

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Article Doi:

https://doi.org/10.31258/jes.9.4.p.2101-2111

A B S T R A C T

The transition to the Merdeka Curriculum has significantly impacted Indonesia's education system, requiring both teachers and students to adopt more innovative and creative learning approaches. However, appropriate teaching materials are still limited, particularly for abstract topics such as acid–base concepts. This study aimed to develop chemistry teaching materials equipped with demonstration videos to support learning in accordance with the Merdeka Curriculum. The research employed an Educational Design Research (EDR) approach using Plomp's development model, which includes preliminary research, prototyping, and assessment stages. Data were collected through interviews and questionnaires on validity and practicality, and analyzed using Aiken's V formula. The results showed a validity score of 0.85, indicating a high level of validity. Practicality tests showed a score of 94% from teachers and 92% from students, categorized as very high. These findings conclude that the developed acid–base teaching materials for Phase F senior high school students are valid and practical for implementation in Merdeka Curriculum learning.

1. Introduction

The education system in Indonesia has undergone significant changes in recent years, especially after the COVID-19 pandemic which has had a major impact on various aspects of life, including education. The pandemic forced sudden changes in the learning process, prompting the Ministry of Education and Culture to issue Circular Letter No. 4/2020 on emergency education policies to limit the spread of the coronavirus (Nasional, 2020; Pebriyandi et al., 2022). In response, home-based learning was implemented, which, while appropriate in terms of mitigation, exacerbated the learning crisis due to the lack of direct interaction between teachers and students. The impact of this change is felt not only by students who haveto adjust to online learning methods but also by teachers who are faced with the

challenge of developing materials that can be effectively delivered through online media.

After COVID-19 subsided, the government issued the Merdeka Curriculum policy as an effort to restore learning. This curriculum has a flexible framework, focuses on essential material, and supports the development of learners' character and potential (Permendikbud, 2022). The Merdeka Curriculum continues the principles of a competency-based and contextualized curriculum, which is designed to meet the needs of learners holistically. This curriculum also emphasizes the importance of giving educators the freedom to determine learning methods that best suit students' needs, so that they can learn according to their abilities and interests. In its implementation, Merdeka Curriculum is expected to create a more inclusive and student-centered learning environment. As a reference for the teaching and learning process, the curriculum has a vital role in structuring learning, but the curriculum in Indonesia has undergone many changes that have the potential to confuse various parties (Vhalery et al., 2022).

Technological developments and the demands of the Industrial Revolution 4.0 and Civilization 5.0 have also influenced Indonesian education, emphasizing the importance of developing 21st-century skills, such as critical thinking, collaboration, communication, and creativity (4C). In this context, the Merdeka Curriculum is expected to foster learning independence by providing more space for teacher and student creativity, in contrast to the more rigid approach of the 2013 Curriculum (Nurkamiden, 2021). In an era where information can be accessed quickly, the Merdeka Curriculum encourages students to actively seek knowledge and think independently, not just rely on instructions from the teacher. Characterized by project-based learning and a focus on developing soft skills according to the Pancasila Learner Profile, this curriculum offers a more flexible framework to support educational success in the modern era (Jojor & Sihotang, 2022). Project-based learning allows learners to hone their critical and creative thinking skills through activities that are more applicable and real.

However, the successful implementation of the curriculum relies heavily on the availability of effective and engaging teaching materials that motivate students to understand the material. Unfortunately, students' low interest in reading is a major challenge. Many teaching materials are not attractively designed, with long texts and minimal illustrations or colors, making them less motivating for students (Gustina et al., 2021). A more visual display with colors and images can help attract attention and improve understanding through the imagination generated by illustrations (Salyani et al., 2018). Teaching materials that are interactive and equipped with videos or moving illustrations will make it easier for students to understand the material presented. Therefore, the development of teaching materials that are visually appealing and in accordance with student needs is needed to support the Merdeka Curriculum.

Based on these problems, researchers aim to develop Chemistry teaching materials equipped with demonstration videos for Acid-Base Concept material. This teaching material will be arranged with a systematic structure, detailed content, and more

varied images and colors so that it can attract students' reading interest and support the learning process. Demonstration videos in teaching materials are expected to provide clearer visualization, especially for concepts that are difficult to understand only with text or static images. Thus, this research is entitled "Development of Chemistry Teaching Materials Equipped with Demonstration Videos on Acid-Base Concept Material to Support the Independent Curriculum".

2. Methodology

This research is an *Educational Development Research* (EDR), with the development model used is the Plomp development model developed by Tjreed Plomp. The Plomp model consists of 3 main stages, namely *preliminary research*, *prototyping stage,* and *assessment phase* (Plomp, 2013). However, this stage of the research was not conducted because the research was limited to the prototyping stage.

This research was conducted at SMAN 9 Padang in the 2022/2023 academic year. The research subjects consisted of lecturers of the Chemistry Department of FMIPA UNP, Chemistry teachers, and students at SMAN 9 Padang. The object of the research is chemistry teaching materials on the concept of acid-base based on the independent curriculum for Phase F SMA/MA students. The type of data used in this research is primary data. Primary data is data obtained directly from lecturers, teachers, and students through validity and practicality questionnaire testing. The data analysis technique used is descriptive statistical analysis. The validity analysis technique uses the Aiken V scale based on categorical judgments modified from Boslaugh (Aiken, 1985). Aiken's V formula is as follows.

$$v = \frac{\Sigma s}{n(c-1)}$$

Description:
s : The validator's assigned score minus the lowest score in the category used (s = r-Io), where r is the validator's preferred category score and Ioskor lowest score in the scoring category.
n : Number of validators
c : The number of categories selected by the validator

The V index range is 0 to 1. Validity is acceptable if the V Index value meets the minimum value of validity based on the validity coefficient. The criteria for validity levels are presented in Table 1.

Table 1. Validity Level of Teaching Materials

Interval	Validity
V < 0,80	Invalid
V ≥ 0,80	Valid

(Source: Aiken, 1985)

The practicality analysis technique uses the following modified formula from (Purwanto, 2010).

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

Description:
NP : The sought or expected percent value
R : The raw score obtained by the student
SM : Ideal Maximum Score of the test in question
100 : Fixed number

The level of practicality of the Merdeka Curriculum chemistry teaching materials will be seen after being converted to categories such as Table 2 below.

Table 2. Practicality Level of Teaching Materials

Value	Category	Practicality
86%-100%	Very High	Very Practical
76%-85%	High	Practical Enough
60%-75%	Simply	Practical
55% - 59%	Low	Less Practical
≤54%	Very Low	Not Practical

(Source: Purwanto (2010) in Yunus & Sardiwan (2018)).

3. Results and Discussion

Results

A. Preliminary Research

At this stage, several activities were carried out consisting of needs and context analysis, literature study, and conceptual framework development.

a. Needs and Context Analysis

At this stage, researchers collected data through literature studies and structured interviews with three chemistry teachers from high schools who have implemented the Merdeka Curriculum. The literature study shows that the Merdeka Curriculum was created in response to changes in education due to COVID-19, which demanded rapid adjustments and caused limitations in suitable teaching materials (Pebriyandi et al., 2022).

Interviews were conducted with three teachers from SMA Negeri 9 Padang, SMA Negeri 8 Padang, and SMA Negeri 3 Padang to obtain a variety of perspectives. The results of the interviews revealed that curriculum changes caused teachers to still use old teaching materials because the available teaching materials were less structured. This creates a need for teaching materials for the Merdeka Curriculum that are coherent and easy to understand, especially for acid-base concept material. From this needs analysis, researchers developed teaching materials that support the

Merdeka Curriculum for acid-base concept material as an alternative that can be used in schools in phase F SMA / MA.

Analysis context was conducted to detail the scope of learning outcomes, materials, and strategies to be selected in the development of teaching materials. The results of the context analysis show that by the end of phase F, learners are expected to be able to respond to global issues and actively solve problems with abilities such as identifying, designing solutions, and communicating ideas through projects or visual simulations related to issues such as alternative energy, global warming, and environmental pollution. This achievement supports the SDGs while developing noble morals and scientific attitudes such as honesty, critical thinking, innovation, and cooperation.

b. Literatur Study

This literature study includes several supporting studies related to the implementation of the Merdeka Curriculum and the development of teaching materials. Research (Rahayu et al., 2022) examines the implementation of the Merdeka Curriculum at the driving school. The results show that the implementation of this curriculum has been optimal although there are still challenges. The success of implementing the Merdeka Curriculum in schools depends heavily on the support of principals and teachers who must be committed to making changes, including changing the mindset of school human resources to be ready to accept change (Fauzi, 2022). Research by Sumarsih et al. (2022) also supports these results, highlighting that the Merdeka Curriculum in driving schools produces students who are noble, critical, creative, and able to work together. The principal plays an important role in encouraging participatory programs and innovation, with the support of teachers who are active in realizing the vision of the driving school. In addition, research (Situmorang et al., 2015) discussed the development of high school chemistry textbooks based on innovation and character education. The results show that this textbook supports the achievement of *student* competencies according to the curriculum, facilitates chemistry learning, and shifts to a *student-centered* approach, while increasing students' positive character.

c. Conceptual Framework Development

This stage involves developing the conceptual framework of the research through needs analysis, context analysis, and literature study, to show the relationship between the problems found and the proposed solution.

B. *Prototyping Stage*

This stage produced 4 prototypes. At each prototype formation, a formative evaluation was carried out which aimed to improve the quality of the product.

a. Prototype I

Prototype I is the result of the design and realization of the initial research, including cover, table of contents, concept map, essential material, related exercises, and

answer keys, with complete and systematic content. The design can be seen in Figure 1.

Figure 1. *Prototype* I Design

b. Prototype II

Prototype II is the result of formative evaluation of *self-evaluation* in Prototype I. At this stage, researchers checked the completeness of the teaching material components using a questionnaire and completed the missing components. Based on the self-evaluation, the teaching materials for renewable energy materials are complete, so there is no need for revisions to Prototype I.

c. Prototype III

Prototype III is the result of a formative evaluation from *expert review* and *one-to-one evaluation* on prototype II.

1) *Expert Review*

Expert Review is an activity to validate prototype II to get the validation level of prototype II. The validity test was carried out by five validators. The validation results from five expert reviewers are summarized in Table 3.

Table 3. Validation Data Processing Analysis Results

No	Aspects Assessed	V	Category of Validity
1	Content Component	0,82	Valid
2	Presentation Component	0,86	Valid
3	Language Component	0,90	Valid
4	Graphics	0,85	Valid
5	Overall Percentage	0,85	Valid

Description: V = Aiken index value V

Prototype III was declared valid with an average Aiken V value of 0.85, but there were suggestions for improvement from the validators. Revisions were made to Prototype II according to the input from the validators, resulting in Prototype III with the suggested adjustments. Table 4 presents the suggestions given by reviewers and the corresponding improvements made.

2) *One-to-One Evaluation*

At this stage, interviews were conducted with three students of class XI Phase F SMA Negeri 9 Padang who had studied the Acid-Base Concept material to test their responses to the revised Prototype II. This evaluation aimed to assess the suggestions given in the previous expert review. The selected learners represent the population with various genders and ability levels. The interview results showed that the design of the teaching materials was attractive, the presentation of the material was easy to understand, and the material components helped students' understanding.

d. Prototype IV

This stage is the result of a formative evaluation of the small group evaluation on Prototype III. The evaluation aims to assess the practicality of the teaching materials supporting the Merdeka Curriculum on the Acid-Base Concept material, focusing on ease of use, time efficiency, appearance, and benefits. The Small Group Test was conducted on 9 students of class XII Phase F SMA Negeri 9 Padang who had studied the Acid-Base Concept material, as well as 2 chemistry teachers who taught in class XI Phase F SMA Negeri 9. Student responses from the small group test are presented in Table 5.

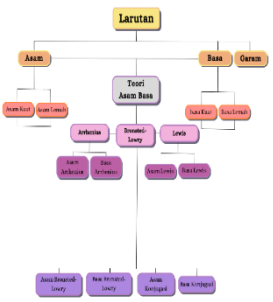
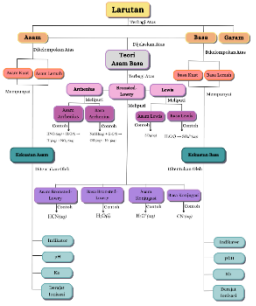
Table 5. Results of *Small Group* Particality with Students

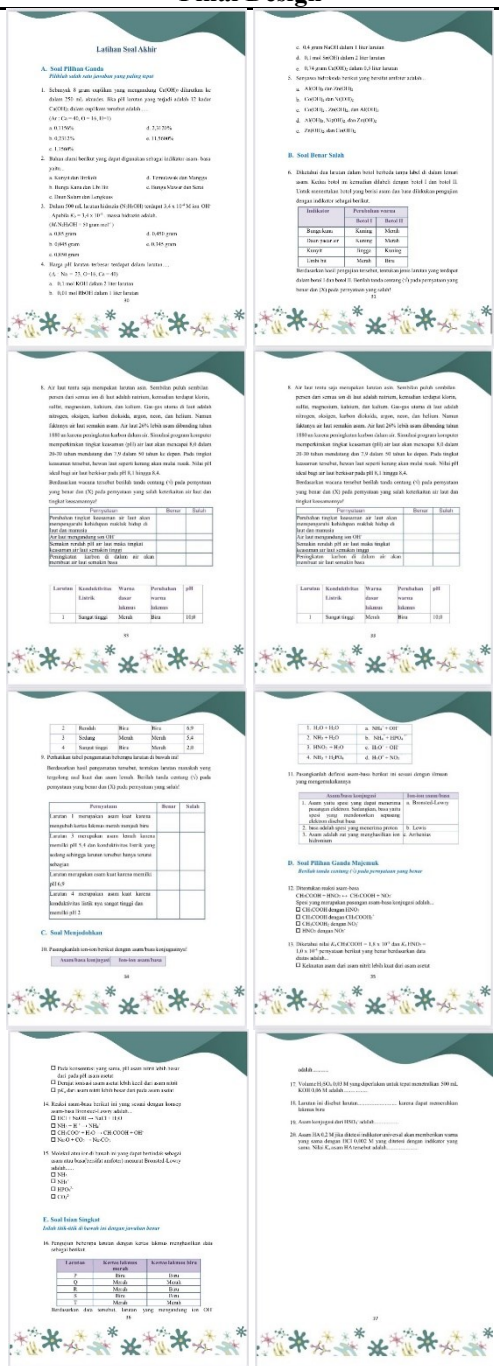
No	Aspects Assessed	Percentage	Practicality Category
1	Ease of use	99%	Very Practical
2	Learning Efficiency	83%	Practical Enough
3	Benefits	94%	Very Practical
Overall Percentage		92%	Very Practical

Table 6. Practicality Results for Teachers

No	Aspects Assessed	Percentage	Practicality Category
1	Ease of use	91%	Very Practical
2	Learning Efficiency	100%	Very Practical
3	Benefits	95%	Very Practical
Overall Percentage		94%	Very Practical

Table 4. Suggestions and Snapshots of Improvements Made

No	**Advice**	**Results**	
		Initial Design	**Final Design**
1.	Provide conjunctions on the concept map so that it is easily understood by students. In addition, add sub-subs from the concept map because it is considered still lacking.		

No	Advice	Results	
		Initial Design	**Final Design**
2.	Changed the questions in the teaching materials, because the questions made were not in accordance with the Merdeka Curriculum.		
3.	Change the writing of a reaction to match the rules of reaction writing.		
4.	Explain scientific terms that are unfamiliar to students, so that students understand the meaning of the scientific terms.		

Discussion

This study aims to develop teaching materials to support the Merdeka Curriculum on Acid-Base Concept material. The quality of the developed product is evaluated based on three criteria: validity, practicality, and effectiveness (Rochmad, 2012). However, in this study, the focus of development is limited to determining the level of validity and practicality of teaching materials.

The validation test in this study was conducted to assess the teaching materials developed through *expert review*, using a validation questionnaire as an assessment instrument. Content and media validity assessments were analyzed using Aiken's V method, with results compared on Aiken's V scale. The validators involved in the content validity test consisted of 5 people: 3 Chemistry lecturers from Padang State University and 2 teachers of SMA Negeri 9 Padang. The assessment aspects include content, presentation, linguistic, and graphical components. The validity test results show that the content component is valid with an Aiken V index of 0.82, which means that the teaching materials follow the Merdeka curriculum and learning outcomes. The presentation component is also valid with an Aiken V index of 0.86, indicating that the presentation of material and systematics of teaching materials follow the learning objectives and Merdeka curriculum. The linguistic component is valid with an Aiken V value of 0.90, indicating the use of clear and easy-to-understand language, while the graphic component is valid with an Aiken V value of 0.85, indicating good layout, appearance, and design. Overall, the average Aiken V index value is 0.85, which falls into the valid category. Thus, the chemistry teaching materials for acid-base concept material in class XI phase F SMA/MA are declared valid and ready to be tested.

The practicality test was conducted to determine the ease of use of the developed product. A material is said to be practical if the teaching material is easy to use and fits the purpose of the development (Plomp, 2013). Product practicality can be assessed from the aspects of ease of use, efficient learning time, appearance, and benefits of teaching materials (Sukardi, 2011). This test was carried out on students of class XII Phase F SMA Negeri 9 Padang who had studied the material Acid-Base Concepts. In the small group evaluation test, nine students gave an average score of 92%, which indicated that the teaching materials were very practical. Practicality tests on two chemistry teachers resulted in an average score of 94%, also in the very practical category. Based on these two results, chemistry teaching materials for AcidBase Concept material in class XI Phase F SMA/MA are declared practical and ready to be tested. This teaching material has an attractive appearance, easy-to-understand language, delivery of material in accordance with learning outcomes, and a systematic sequence of material so that it effectively helps students' understanding.

4. Conclusion

This research concludes that the development of chemistry teaching materials for the acid–base concept aligned with the Merdeka Curriculum is both feasible and

beneficial. The integration of demonstration videos enhances students' comprehension by providing clear visualizations of complex concepts. These materials are systematically structured, visually engaging, and well-received by both educators and students. Their practicality and alignment with curriculum goals make them a valuable resource to support effective and independent learning in the classroom. The development process has also shown the importance of continuous evaluation and refinement based on expert and user feedback, ensuring that the materials meet both pedagogical standards and user expectations.

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How to cite this article:

Nabilah, H., & Hardeli. (2025). Development of Chemistry Teaching Materials with Demonstration Videos on the Acid–Base Concept to Support the Merdeka Curriculum. *Journal of Educational Sciences*, *9(4)*, 2101-2111.