Jurnal Kependidikan:
Jurnal Hasil Penelitian dan Kajian Kepustakaan di Bidang Pendidikan, Pengajaran dan Pembelajaran
https://e-journal.undikma.ac.id/index.php/jurnalkependidikan/index

Vol. 10, No. 1 : March 2024
E-ISSN: 2442-7667
pp. 230-241
Email: jklppm@undikma.ac.id

Development of an Innovative Contextual Chemistry Textbook on Hydrocarbon Concepts : Enhancing Students' Mastery of Concepts

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Abstract: This research aims to develop an innovative contextual chemistry textbook on hydrocarbon concepts to enhance students' mastery of the subject. This research method used research and development with the ADDIE model, which consists of Analysis, Design, Development, Implementation, and Evaluation. The study was specifically confined to the development stage, as its primary focus is on assessing the validity of the developed products. The validation process involved two material expert validators, one media expert validator, one practitioner validator, and ten students from Ushuluddin NW Ubung Islamic Boarding School, who served as limited test validators. Quantitative data obtained from the feasibility validation results were analyzed using a percentage formula. Qualitative data in the form of responses and suggestions for improvement from validators are used as considerations for making revisions. The results showed that the validator assessment resulted in a very satisfactory average percentage, with material expert validators reaching 83% (very feasible category), media expert validators reaching 75% (feasible category), practitioner validators reaching 91% (very feasible category), and Limited student trials reached 89% (very feasible category). Therefore, this textbook successfully met high validity standards and can be considered suitable for use in the learning process.

Article History
Received: 14-09-2023
Revised: 11-11-2023
Accepted: 12-01-2024
Published: 09-03-2024

Key Words:
Contextual; Chemistry; Hydrocarbon; Textbook.

How to Cite: Pahriah, P., Safitri, B., & Putrayadi, W. (2024). Development of an Innovative Contextual Chemistry Textbook on Hydrocarbon Concepts : Enhancing Students' Mastery of Concepts. *Jurnal Kependidikan: Jurnal Hasil Penelitian dan Kajian Kepustakaan di Bidang Pendidikan, Pengajaran dan Pembelajaran, 10*(1), 230-241. doi:https://doi.org/10.33394/jk.v10i1.9047

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Introduction

Chemistry is a field of science that studies in detail the properties, structure, composition, changes and energy of matter (Boy Baunsele et al., 2020). In understanding chemistry, there are three important aspects, namely macroscopic, microscopic, and symbolic, which form a comprehensive representation. Macroscopic representation shows a situation that contains real objects that can be seen directly (Dewi & Ahmadi, 2014). The submicroscopic aspect contains the particle level which can be used to describe particles from chemical phenomena such as the movement of electrons, molecules and (Dewi & Ahmadi, 2014). On the other hand, the symbolic aspect contains chemical representations and phenomena through the use of signs, images, algebra, chemical equations and forms of calculations (Dewi et al., 2022).

Hydrocarbon material is a chemical material that contains the most complete representational aspects, including macroscopic, microscopic, and symbolic representation. Therefore, teachers can present these three representations in learning so that students can fully understand hydrocarbon material (Icha al., 2017). In the hydrocarbon material, there is sub-material with a level of understanding that includes the presence of hydrocarbon compounds in everyday life (macroscopic), determining the name and molecular image of the

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E-ISSN: 2442-7667
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hydrocarbon compound (microscopic), determining the name of the structure of the hydrocarbon compound (symbolic).

Understanding the concept of hydrocarbon material is considered difficult and abstract due to the students' lack of willingness to repeat the lessons given by the teacher (Sari & Arianti, 2022). Non-innovative learning processes (Shidqie, 2019), lack of student involvement in the learning process (Witari al., 2019), use of monotonous learning methods in the form of lectures resulting in a lack of two-way communication (Wahyuni & Hardeli, 2019. Roudloh et al., 2023) and lack of use of references and learning resources (Armiati & Pahriah, 2015).

The results of observations carried out at the Ushuluddin NW Ubung Islamic Boarding School show that mastery of chemical concepts is still lacking, as evidenced by the low average achievement of student learning outcomes, which stands at 65. This finding is in line with the results of research conducted by Siregar et al., (2021) and Sepdyana Kartini et al., (2022), which concluded that more than 80% of respondents found it difficult to understand hydrocarbon material.

Factors that can be identified as causes of low mastery of this concept include two aspects. First, the chemistry learning carried out by teachers so far seems separate from students' daily experiences. As a result, students tend to assume that chemistry lessons have no relevance to their lives. The second factor that plays a role is the lack of availability of adequate textbooks, which results in students having difficulty in carrying out the learning process (Tamara et al., 2022).

Silaban defines concept mastery as the effort that must be made by students in recording and retrieving a certain amount of information from certain subject matter. This information can be used to solve problems, analyze and interpret events that occur in certain situations (Suminarsih, 2023). According to Suranti et al., (2017) it is important for someone to master a concept because this allows them to communicate better, classify ideas, ideas, or events that they experience in everyday life. Students who develop mastery of concepts will be more able to apply procedural knowledge compared to students who only rely on rote memorization and remembering information. In other words, mastery of concepts allows students to have a deeper understanding.

Students' low mastery of concepts can be overcome through various improvement efforts. These efforts are not only limited to the roles of teachers and students but involve all aspects of the learning process. One aspect that needs to be considered is the use of textbooks that are developed innovatively. These textbooks should encompass interactive elements, multimedia resources, and real-world applications to enhance student engagement and understanding. By integrating technology, visual aids, and practical examples, textbooks become dynamic tools that can adapt to various learning styles, bridging the gap between theoretical concepts and practical applications. According to Santayasa, as mentioned in Tampubolon et al., (2015), the use of textbooks in learning has several advantages, including (1) increasing student motivation; (2) after the evaluation is carried out, the teacher and students know it is true; (3) students achieve results according to their abilities; (4) learning materials are distributed more evenly in one semester, and (5) education is more effective, because textbooks are arranged according to academic levels. The textbooks developed can be textbooks with a contextual approach.

Contextual learning is a teaching and learning concept that helps teachers link material taught in class with real-world situations and encourages students to make connections between the knowledge they have and its application in their lives as individuals, family members and society (Muhartini et al., 2023). Contextual chemistry textbooks are

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chemistry learning materials or materials that contain contextual examples of chemistry arranged systematically based on the principles of contextual learning, namely: constructivism, inquiry, questions, learning community, modeling, reflection, actual assessment (authentic assessment) (Yanti, 2022). The contextual approach in textbooks is crucial because many students face difficulties in connecting chemistry concepts with real-life situations. By employing this approach, students can more easily comprehend and relate lesson materials to practical situations in their daily lives. Research indicates that this approach not only enhances learning outcomes (Susanti et al., 2020) but also improves students' motivation and engagement while reducing anxiety in the learning process (Yunitasari et al., 2023).

Based on the analysis of hydrocarbon materials, it shows that they are closely related to everyday life. Contextual learning, which connects material with real life, is very suitable for understanding hydrocarbon material in chemistry learning. In this regard, researchers hope to be able to produce products in the form of quality textbooks in accordance with quality criteria and standards that can help students understand and master chemistry lessons and increase students' understanding of concepts. In related research, Mashami et al., (2021) found that contextual learning modules integrated with augmented reality were effective in improving students' critical thinking skills. Wulandari et al., (2019) show that the development of contextual-based modules on colloidal materials meets the National Education Standards Agency (BSNP). Meanwhile, Prasetiowati & Muna, (2022) concluded that a contextual-based practical instruction module on acid-base material for SMA/MA is a suitable learning medium for improving students' contextual learning abilities.

Research conducted by Miranda et al., (2022) shows that developing student worksheets (LKPD) based on a contextual approach to colloidal material is a suitable method for students. Likewise, research by Dalimunte (2023) confirms that the development of contextually based e-modules on mole concept material is an independent learning resource that is suitable for class contextually based on the subject matter of buffer solutions is very suitable. Based on these findings, this study aims to develop an innovative contextual chemistry textbook on hydrocarbon concepts to enhance students' mastery of the subject.

Research Method

This research method used research and development with the ADDIE which has five stages, namely (1) Analysis; (2) Design, (3) Development, (4) Implementation, and (5) Evaluation (Muruganantham, 2015). The research carried out was limited to the development stage because this research only tested the validity of development products. The research location was at the Ushuluddin NW Ubung Islamic Boarding School, Central Lombok. The selection of Pondok Pesantren Ushuluddin NW Ubung, Central Lombok, as the research location was framed by its uniqueness as a specialized religious education environment, where cultural context, values, and learning challenges can provide different perspectives related to chemistry education. The textbook test subjects were carried out on 10 students from class XI Ushuluddin NW Ubung Islamic Boarding School who have taken hydrocarbon material. The textbook trial would be carried out in August 2023 in semester 1 of the 2023/2024 academic year. Based on the ADDIE model, development research includes several main stages, namely:

1) Analysis Stage

   The analysis stage is the stage where researchers analyze the need for developing textbooks and analyze feasibility. In the analysis stage, researchers carried out three types

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of analysis, which included needs analysis, curriculum analysis, and student characteristics analysis.

2) Design Stage
This stage begins to design a textbook, which is developed according to the results of the analysis carried out previously. At the design stage of this module, the following activities were carried out. (a) formulating learning objectives, (b) determining and designing appropriate learning models, (c) designing learning tools, and (d) compiling assessment and evaluation instruments. All designs made in this second stage were still at the conceptual level and would be used as a basis in the subsequent textbook development process.

3) Development Stage
After completing the design stage, the next step is the textbook development stage. At this stage of book development, several activities have been carried out. First, textbooks are made according to a previously prepared plan. Next, testing the suitability of textbooks is carried out through a validation process by material experts and media experts and practitioners. The use of a questionnaire is the main instrument in this validation, where the aim is to collect data regarding the suitability of the book that has been developed. Apart from that, questionnaires are also an important instrument in collecting data regarding student responses to textbooks that have been developed. All questionnaires used in this process follow a five-choice answer scale. Data obtained from these instruments is calculated and converted into scores (values) using a percentage formula. After getting a score, the score will then be converted into the following score interpretation criteria.

Table 1. Score Interpretation Criteria

Percentage (%)	Validity Criteria
0 – 20	Not feasible
21− 40	Not worthy
41− 60	Decent Enough
61− 80	Worthy
81− 100	Very Worthy

Source: Riduwan (2013).

An instrument is said to be valid if the percentage score was ≥ 75%.

Results and Discussion

This research produced a product in the form of a textbook in printed form as a learning textbook. The development stages that have been carried out are as follows:

1) Analysis Stage

The Analysis Stage is a very important first step in product development. Product development started from an initial analysis of chemistry learning at the Ushuluddin NW Ubung Islamic Boarding School and the chemistry curriculum. Based on the results of the learning analysis, several problems were found related to the learning process and available textbooks. Chemistry learning has been taking place with limited learning resources. Based on the results of interviews, it was revealed that the dominant learning method used was the lecture method, which may be one of the causes of difficulties in understanding hydrocarbon material. Analysis of hydrocarbon material in the 2013 Curriculum directs the learning objectives to be achieved through learning activities in textbooks. Based on basic competencies and core competencies, the following learning indicators are obtained: 1) Students are able to identify the carbon element from hydrocarbon compounds, 2) Students

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are able to explain hydrocarbon compounds and their sources, 3) Students are able to explain the properties of hydrocarbon compounds, 4) Students are able to make isomers -isomers of hydrocarbon compounds, 5) Students are able to identify the reactions of hydrocarbon compounds.

2) Design Stage

The next stage is designing the textbook design. Textbook design paid attention to book components, writing layouts, images, and content plans that were appropriate to contextual learning. Textbooks consist of a cover, introduction, material, summary, competency test and bibliography. The design was then outlined in a book. Meanwhile, the questionnaire grid is arranged based on assessment aspects. Aspects assessed in the material expert validation questionnaire include the presentation of textbooks, appropriateness of presentation, and appropriateness of contextual components. Media expert validation includes the presentation of textbooks, appropriateness of graphics, and quality of display. Meanwhile, the aspects assessed in the limited trial questionnaire are material quality, presentation quality, language quality/readability, and contextual learning component quality.

3) Development Stage

At the development stage, the textbook is created using Microsoft Word based on the draft that has been prepared in the previous stage. The developed textbook has a B5 size (17.5 x 25 cm), consisting of 109 pages divided into several sections. The use of the B5 size for the textbook in the development stage is chosen because the B5 size provides adequate space to present information clearly and structure without being too large or too small. The following is a picture of several parts in the appearance of the development book presented in Figure 1 below.

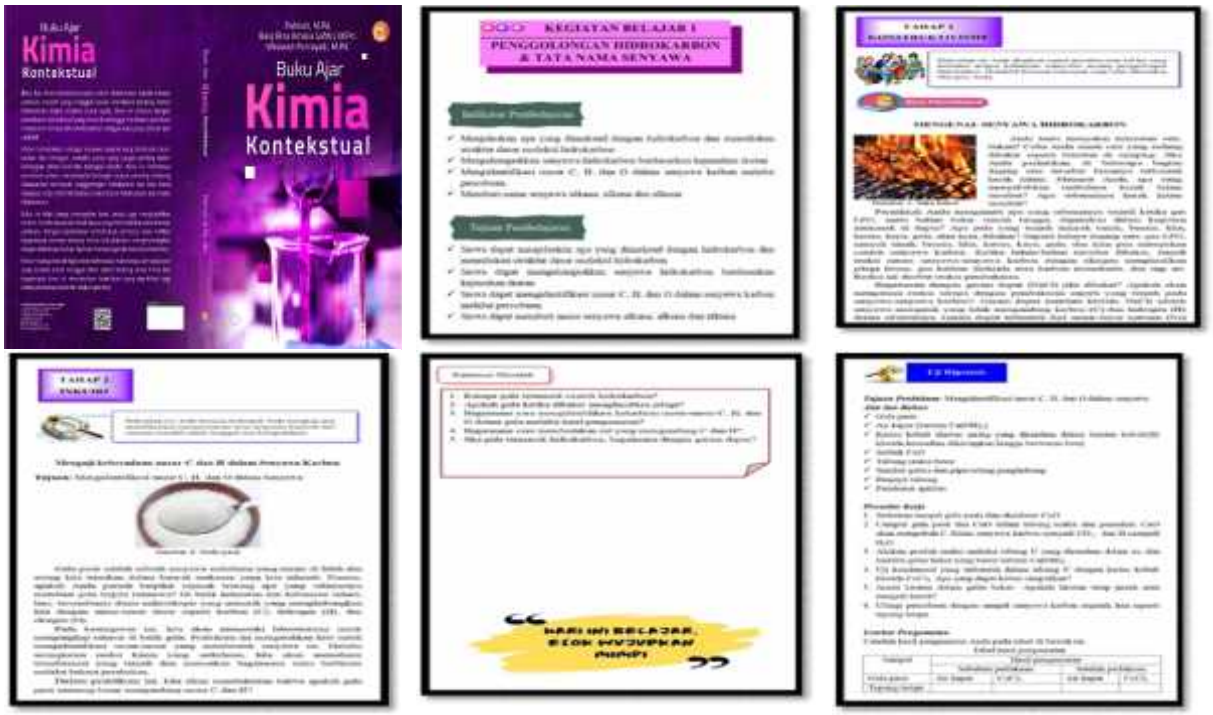

Figure 1. Display of a contextual chemistry textbook

After the development of the contextual chemistry textbook was complete, the next step was to carry out validation. Validation results by material experts, media experts and practitioners were available in the form of quantitative and qualitative data. Qualitative data in the form of suggestions and comments will serve as a guide for researchers to make improvements to the textbooks that have been developed.

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a) Validation by material expert lecturers

The material expert validators were two UNDIKMA chemistry education lecturers. The questionnaire used as an instrument is a closed questionnaire consisting of three main aspects with a total of seven assessment items.

Table 2. Quantitative data from material expert validation results

No.	Aspect	Validator I	Validator II	Average score (%)	Criteria
1.	Presentation of textbooks				
	a. Suitability to student needs	4	4	80	Worthy
	b. Material accuracy	4	5	90	Very worthy
	c. Up to date material	4	5	90	Very worthy
	d. Benefits for increasing knowledge insight	4	4	80	Worthy
2.	Feasibility of Presentation				
	a. Presentation support	4	4	80	Worthy
	b. Presentation of learning	4	4	80	Worthy
3.	Feasibility of Contextual Components	4	4	80	Worthy
	Average			**83**	**Very worthy**

Table 3. Qualitative data from material expert validation

Validator	Suggestion
Validator 1	a. Adjust the concept map to the order of the material in the textbook. b. Refine learning indicators and learning objectives that are written too broadly. c. In the hydrocarbon classification material, stage 1 constructivism provides examples of compounds other than hydrocarbon compounds that can be found in everyday life. d. In the hydrocarbon classification material at stage 2 of inquiry, make a problem formulation according to the case study in the constructivism stage and make an introduction/introduction before entering the inquiry stage. e. Create an observation table for material experiment 1. f. In the compound nomenclature material, create your own sub (make it sub B).
Validator 2	a. Add examples of isomers in everyday life besides rice and wood. b. The questions need to be revised to Critical Thinking Skills questions

Based on Table 2, the contextual chemistry textbook that has been developed meets the eligibility criteria for material expert validation with an average material validation score of 83% in the very appropriate category. Meanwhile, the qualitative data listed in Table 3, which includes suggestions and comments, has been corrected by the researcher according to the input and comments provided by the validators.

b) Validation by media experts

Media expert validation is a lecturer from the Information Technology Education Study Program at UNDIKMA. The instrument used is a closed questionnaire consisting of three main aspects with a total of eight assessment items. The results of this assessment can be found in Table 4 for quantitative data and Table 5 for qualitative data.

Table 4. Quantitative data from media expert validation

No.	Aspect	Validator 1	Gain score (%)	Criteria
1.	Presentation of textbooks	5	100	Very worthy
2.	Graphic feasibility			

a. Book size	4	80	Worthy
b. Book cover design			
1. Textbook cover layout	4	80	Worthy
2. Textbook cover typography	4	80	Worthy
3. Textbook cover illustration	4	80	Worthy
c. Book content design			
1. Layout of the textbook contents	5	100	Very worthy
2. Typography of textbook content	5	100	Very worthy
3. Display quality	4	80	Worthy
Average		**75%**	**Worthy**

Table 5. Qualitative data from media expert validation

Validator	Suggestion
Media validator	a. If there are empty spaces, add motivational sentences b. On the cover, add hydrocarbon compounds to make it more representative.

From Table 4, overall, this textbook gets an average score of 75%, this value if converted is included in the decent category. The qualitative data in Table 5 has been corrected according to input and comments submitted by media expert validators.

c) Practitioner Validator

Assessment by practitioners is carried out using the same questionnaire as that given to material expert validators. The results of validation by practitioners can be seen in Table 6.

Table 6. Quantitative data from practitioner validation results

No.	Aspect	Validator	Gain score (%)	Criteria
1.	Presentation of textbooks			
	a. Suitability to student needs	5	100	Very worthy
	b. Material accuracy	5	100	Very worthy
	c. Up to date material	5	100	Very worthy
	d. Benefits for increasing knowledge insight	4	80	Worthy
2.	Feasibility of Presentation			
	a. Presentation support	4	80	Worthy
	b. Presentation of learning	4	80	Worthy
3.	Feasibility of Contextual Components	5	100	Very worthy
	Average		**91**	**Very worthy**

Based on Table 6, the contextual chemistry textbook that has been developed meets the eligibility criteria with an average score of 91% in the very appropriate category. Suggestions from validators become a guide for researchers in carrying out revisions. Suggestions from practitioner validators can be found in Table 7.

Table 7. Qualitative data from practitioner validation

Validator	Suggestion
Practitioner validator	a. Provide keywords in this textbook that help students correct their answers and be able to reflect on the results obtained.

From this explanation, the contextual chemistry textbook has gone through a validation process and was declared suitable for use in chemistry learning, especially hydrocarbon material. The assessment results from material expert validators reached a score of 83%, with the criteria "very feasible." The assessment from media expert

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validators gave a score of 75%, with the criteria of "decent." Furthermore, the assessment from practitioners gave the highest score, namely 91%, with the criteria of "very feasible." Thus, contextual chemistry textbooks on hydrocarbon material are very suitable for use as a chemistry learning resource in schools.

This research on the development of contextual chemistry textbooks is in line with research by Dewi et al., (2018) which states that the development of entrepreneurship-based CTL learning tools to increase students' learning motivation on petroleum material is suitable for use in learning and can increase students' learning motivation. Salsabila & Nurjayadi, (2019) research shows that the contextual-based electronic chemistry module as an enrichment medium for elemental chemistry material is suitable for use as a learning medium for class XII MIPA SMA/MA students on elemental chemistry material. Apart from that, Qurniati, (2021) research regarding the development of a contextual chemistry textbook that is integrated with Islamic values is very suitable for use in learning. Febriyanti & Muna, (2023) shows that Google Sites contextual-based learning media based on the main material of buffer solutions is also very suitable for use in the learning process.

After being declared suitable by material experts, media, and practitioners, it was continued with a practicality test on the use of contextual chemistry textbooks for students. The results of these student assessments can be used as a basis for revising textbooks if necessary. This practical test involved 10 class XI students who had studied hydrocarbon material. The student's trial assessment includes four aspects, namely aspects of material, presentation, language/readability, and quality of contextual learning components. The overall results of student trials are presented in Table 8.

Table 8. Student responses to the textbooks developed

Aspect	Gain score (%)	Criteria
Material quality	88	Very worthy
Quality of presentation	86	Very worthy
Language quality/readability	90	Very worthy
Quality of contextual learning components	93	Very worthy
Average	**89**	**Very worthy**

Based on the data contained in Table 8, it was found that the average of student responses was 89%, which is in the very appropriate category. These results indicate that the contextual chemistry textbook meets good standards for use in the learning process. Data regarding each student's response to the use of contextual chemistry textbooks is presented in Table 9 and Table 10.

Table 9. Quantitative student data on the textbooks developed

No.	Name	Gain score (%)	Criteria
1.	Siti Salmah	86	Very worthy
2.	Sahrul Gunawan	89	Very worthy
3.	Tina Kurnia	85	Very worthy
4.	Hobi Paozan Gare	86	Very worthy
5.	Usnul Hotimah	86	Very worthy
6.	Nova Kharianti	88	Very worthy
7.	Harmoningsih	89	Very worthy
8.	Muhamad W.D.	95	Very worthy
9.	Alpatihbastian	98	Very worthy
10.	Khaerun Nisa	85	Very worthy
Average		**89**	**Very worthy**

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Table 10. Students' qualitative data on the textbooks being developed

No.	Student's name	Student responses
1.	Siti Salmah	The material is good
2.	Sahrul Gunawan	Keren
3.	Tina Kurnia	Quite understandable, clear and good
4.	Hobi Paozan Gare	I think this book is very helpful for learning things about chemistry, very helpful.
5.	Usnul Hotimah	The way it is presented is easy for me to understand
6.	Nova Kharianti	Oke, keren
7.	Harmoningsih	The material is okay
8.	Muhamad Wirham Dani	The material can be understood quickly
9.	Alpatihbastian	-
10.	Khaerun Nisa	Textbooks now make it very easy for us to understand the material on hydrocarbon compounds

Based on student responses in Table 9 and Table 10, the use of contextual chemistry textbooks helps students overcome difficulties in understanding hydrocarbon material. This finding also received support from research by Mashami et al., (2021) which showed that contextual learning modules integrated with augmented reality succeeded in improving students' critical thinking skills on chemical bonding material. In addition, research by Giri et al., (2020) shows that the contextual approach is very effective in learning electrochemistry, with the experimental group achieving a higher level of mastery of learning outcomes than the control group.

There is a significant difference in learning outcomes between students who use contextual-based solution colligative property teaching materials with the 5E Learning Cycle approach and students who use teacher-made diktats, this is in accordance with Azyyati, (2018) research. Apart from that, the Contextual Teaching and Learning (CTL) module which is oriented towards green chemistry has also proven to be effective in increasing students' scientific literacy, as found in research by Ahmadi et al., (2016).

Conceptually, the results of this study illustrate that the development of a contextual chemistry textbook on hydrocarbon material can be an effective solution to address students' difficulties in understanding. Integrating context into chemistry learning encourages students to connect hydrocarbon concepts with real-world situations, deepening their understanding in line with previous research findings on the effectiveness of the contextual approach in the context of chemistry and related chemical sciences. Practically, these findings guide the development of chemistry textbooks focusing on contextualizing hydrocarbon material. Textbooks can be designed by integrating practical situations, case examples, or technological applications to enhance student engagement and appeal. By adopting a contextual approach, teachers can reinforce students' understanding of hydrocarbons in the context of everyday life.

Conclusion

Based on the results of the research and discussion, it can be concluded that the contextual chemistry textbook has gone through a series of feasibility tests by various parties, including material experts, media experts, practitioners, and a limited test with 10 students. The results of this feasibility test are as follows: material experts provide a very feasible assessment with a score of 83%, media experts provide a feasible assessment with a score of 75%, and practitioners provide a very feasible assessment with a score of 91%. The students' limited

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test also resulted in an average score of 89%, which is in the very decent category. Based on the feasibility test results reflecting positive responses from various parties involved, this contextual chemistry textbook was declared very suitable for use in the learning process. It shows that this textbook has great potential to improve students' understanding of chemical concepts, especially hydrocarbon material.

Recommendation

There are three suggestions that can be proposed based on the results of this research:

1) Because this research only covers the contextual chemistry textbook development stage, it is important to proceed to the implementation stage. This will help in directly evaluating the effectiveness of the textbook in improving students' understanding of chemistry concepts. By implementing it in actual classes, it can be measured to what extent this textbook contributes to student learning.
2) In addition, it is recommended to develop contextual chemistry textbooks on other chemistry materials. By developing more material, this textbook can become a more complete resource and support a comprehensive understanding of chemical concepts.
3) Teachers are encouraged to implement contextual textbooks in their teaching. By using these textbooks, it is hoped that teachers can create engaging and relevant learning experiences for students. Utilizing real-life contexts, these textbooks can assist students in better understanding chemical concepts. Teachers can also integrate contextual approaches into their teaching methods, such as case-based discussions, practical experiments, or research-based projects. This can enrich students' learning and help them see the connections between chemical concepts and everyday situations.

Acknowledgment

We express our sincere and deep gratitude for the support and great contribution of LPPM UNDIKMA which has funded this research through an internal research grant scheme because without financial assistance this work would not have been possible.

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E-ISSN: 2442-7667
pp. 230-241
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