Need of chemistry book developed by 4S TMD models on hydrocarbon to increase knowledge building environment eleven-grade students

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Abstract. In this article, we explain the needs of chemistry book developed by 4S TMD models on hydrocarbon to increase knowledge building environment eleven-grade students. The Knowledge Building Environment has built students' knowledge so that when implemented in teaching materials it can support the development of ideas for students but there are still no teaching materials based on the knowledge building environment. We use qualitative descriptive research. Data collection instruments used were structured questions and interviews. This study was conducted at senior high schools and vocational high schools with chemistry teachers. The teacher's structure question responses were analyzed descriptively for each item. Based on the results of interviews with chemistry teachers teaching materials in the form of the textbook are still a top priority as a learning resource. School facilities have not supported the use of electronic-based teaching materials due to the unavailability of sufficient projectors for, there are no internet facilities, the textbook is the perfect solution. The results of this study are the basis for us in developing chemistry book by 4S TMD models on hydrocarbon to increase knowledge building environment eleven-grade students that can be used in chemistry learning and teaching in upper high schools.

1. Introduction
Teaching materials can improve students' knowledge building and increase knowledge about the subject matter. Teaching materials are expected to make students master KI, KD, indicators of achievement of learning outcomes, subject matter and learning experience [1,2]. The problem that is often faced by students is the difficulty of understanding the chemical material contained in teaching materials [3]. Ferreira et al state that learning science must emphasize the acquisition of information by students and emphasize more on understanding the use of knowledge and ideas in the subject matter [4]. Research shows that Malaysian students for 12 years have a limited understanding of chemistry because there are no teaching materials that can explain abstract chemical material to be real [5]. KBE has built students' knowledge so that when implemented in teaching materials can support the development of students' knowledge [6]. Teaching materials that are integrated with the KBE have not been too much so that researchers feel the need to develop teaching materials integrated with the KBE.
Teaching materials are an important component in learning systems that are considered to have a role in helping students achieve indicators in basic competencies [7,8]. Thus, teaching materials are one source of learning that strongly supports the learning objectives of students. Chemical books remain a good solution for schools that do not have internet facilities, adequate projectors and quite a lot of computers. Although e-learning teaching materials have been widely used today, printed textbooks remain a reliable choice for teachers in schools. In chemical teaching materials in the form of chemistry books, there are symbols, images, diagrams [9,10]. Chemistry books are very important in teaching chemistry because there are several representations that can help students understand chemical material [11,12]. The material available in teaching materials can be analogies, diagrams, symbols, and images that can enhance students' conceptual knowledge [13–15]. Teaching materials that use material explanations using analogies can solve students' conceptual problems [16–18].

Teaching material is a material that is structured and systematically arranged, explains the learning objectives to be achieved, motivates students to learn, provides tutoring, gives adequate training, provides summaries, is oriented to individual learners [19,20]. Teaching materials are expected to make students master KI, KD, indicators of achievement of learning outcomes, subject matter and a learning experience [1,21]. The four stages of processing teaching materials are the process of selection, structuring, characterization, and reduction-didactic [22]. The first steps are the selection stage that analyzes the chemistry subject curriculum to review core competencies and basic competencies. The structuring phase is to collect and select information by creating concept maps, creating macro structures and making multiple representations [23]. The characterization stage is the stage for developing characterization instruments in an effort to identify difficult concepts using characterization instruments for teaching materials. The didactic reduction stage is the stage to reduce the difficulty level of teaching materials so that instructional materials are easier for students understanding [24]. 4S TMD was chosen as a method of processing teaching materials because with 4S TMD it will produce teaching materials that are appropriate to the cognitive development of students [25]. The stages in 4S TMD integrate the values that can be obtained by students when interacting with teaching materials.

KBE is an environmental-based theory pioneered by Carl Bereiter and Marlene Scardamalia to build knowledge about the surrounding environment. KBE contains values that can build knowledge through the environment related to teaching material [26]. Students can have and display the value of KBE's knowledge building environment, namely: attentiveness, careness, curiosity, critical, moderation, respect for the environment, respect for health and wisdom. The results of the study indicate that important aspects of the development of chemical modules are claimed to be more easily understood by students than many topics found in standard secondary school texts [27]. Based on this, it is necessary to have a chemical teaching material that is made by paying attention to various aspects including phenomena relating to everyday life and having values or skills. Teaching materials make a significant contribution to students' understanding of chemistry from print media to digital devices [28].

2. Methods
This research is based on a qualitative descriptive study. Qualitative descriptive method is a method for discussing the phenomenon that will be discussed in full [29,30]. The subjects of this study were 22 chemistry teachers spread across 4 middle schools and 5 vocational high schools in West Java, Indonesia. This study uses a question instrument that has been validated by experts and interviews related to chemistry teachers' perceptions about chemistry books developed with 4S TMD to develop KBE. The teacher's answers will then be analyzed descriptively on each question. Researchers collected data through interviews with teachers regarding teaching materials and learning methods commonly used on hydrocarbon materials and KBE values known to teachers. Next, the researchers analyzed and drew conclusions related to the book of hydrocarbon chemistry to develop KBE using the 4S TMD method which was suitable for use in high school teaching.
3. Results and Discussion

We have distributed structural questions to twenty-two chemistry teachers in West Java in 4 senior high schools and 5 vocational high schools. Structural questions consist of questions related to teaching materials that will be developed by researchers, then researchers analyze the results of answers from the teacher. Based on the analysis of textbooks available in the library and from publishers. The teacher's answer is shown in Figure 1.

![Figure 1](image1.png)

**Figure 1.** The types of teaching materials in the classroom

The currently available teaching materials still cannot explain the chemical concepts concretely, there are no submicroscopic and macroscopic representations. Current teaching materials should focus more on the phenomena around us so that it is easier for students to understand the material in a concrete and clear manner. Teacher answers are shown in Figures 2 and 3.

![Figure 2](image2.png)

**Figure 2.** Weaknesses and advantages of teaching materials

The teacher believes that teaching materials that can increase student interest and motivation in learning are interactive teaching materials that can display phenomena in everyday life so that it can trigger students' curiosity according to figure 4. So the teacher hopes to find a chemistry book that is equipped with several representations so that students more easily understand chemistry according to figure 5.

![Figure 3](image3.png)

**Figure 3.** Improvements for teaching materials.

![Figure 4](image4.png)

**Figure 4.** Suggestions for types of teaching materials

![Figure 5](image5.png)

**Figure 5.** Other teaching materials that are often used by teachers

Generally, teachers still do not know the term knowledge building environment, but some teachers have little understanding of the knowledge building environment. Teachers also understand that teaching materials that develop a knowledge building environment can help students understand the phenomena of the environment and understand the values that can be applied in everyday life. Teacher answers are found in Figures 6.
Figure 6. The teacher's opinion about knowledge building environment-based teaching materials

Good teaching materials can make students master the material correctly. The values of Knowledge Building Environment [KBE] are attentiveness, careness, curiosity, critical, moderation, respect for environment, respect for health and wisdom [26]. The characterization stage to determine the characteristics of teaching materials that have been made if it is not as expected so it is necessary to improve teaching materials that are at the next stage. The didactic reduction phase aims to reduce difficulties, reduce misconceptions and make teaching materials easy to understand for students.

The stages that need to be carried out are curriculum analysis to the final stage of the due diligence which is integrated with each other and supports each other. After going through each stage to develop teaching materials, later can produce teaching materials that have good quality so that it can increase the acquisition of knowledge for students.

In the teacher's view of the chemistry book developed with 4S TMD on hydrocarbon material to develop KBE, 22 teachers from 4 Senior High Schools and 5 Vocational High Schools teachers, all teachers consulted had a good view of the use of chemistry books. Based on the views of teachers, chemistry books are a source of learning which is still a top priority. School facilities do not yet support the use of electronic-based teaching materials because there are not enough projectors available for each class, there are no internet facilities so chemical books are the right solution. With chemistry books, students can learn according to student needs so that learning is more directed by providing broader information for students [31,32].

Chemistry books developed with 4S TMD on hydrocarbon materials to develop KBE can build student knowledge [6]. So, the chemistry book can support the development of ideas for students. The developed chemistry book is expected to be able to direct students to get knowledge about hydrocarbon material correctly through the values contained in KBE. According to the teacher, chemistry books with various facilities and completeness are very helpful to find learning resources with the complete subject matter. The interaction between teacher and students is very important in the learning process that can improve students' understanding [11,33]. Students sometimes have difficulty in imagining a concept of subject matter so students cannot understand the material as a whole [34–36]. Educators do not need to worry about providing material that is misconception because teaching materials using chemical books developed with 4S TMD to develop the knowledge building environment have been validated by experts and have gone through didactic reduction stages, so that these teaching materials are truly tested and have the potential to reduce misunderstanding in students. Chemistry books are dubbed as teaching materials that have the potential to make classroom learning effective and efficient.

4. Conclusion
This qualitative study states that the role of chemistry books on hydrocarbons with 4S TMD to develop KBE is important. The use of chemical books can help increase the quality of education based on the values contained in KBE. Chemistry books today aim to develop student-centered learning so that KBE must be owned by students. Chemistry books are important tools for teaching and learning that can help develop students' knowledge because chemical books contain various representations that can affect student learning [37]. This research requires further research to be able to prove the conclusion. Therefore, suggestions for this study are highly recommended. The number of research participants will strengthen the data presented about the chemistry textbook developed using 4S TMD on hydrocarbon material to develop the KBE.
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