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Development of Teaching Materials in the From of Elektronic Book Integrated with Generic Science Skill in Chemical Equilibrium

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Abstract: Development of Teaching Materials in the Form of Electronic Books Integrated with Generic Science Skills in Chemical Equilibrium Selection of teaching materials is an important part of learning, therefore teachers can develop appropriate teaching materials to increase the effectiveness of the learning process. Thus, the research was conducted to develop teaching materials in the form of electronic books integrated with Generic Science Skills (KGS) to improve students' high level thinking skills in chemical equilibrium material in Class XI Senior High School at Laksamana Martadinata Private High School Medan through research and development (R&D) the 4D model (Define, Design, Development, and Disseminate). The development of teaching materials starts from (1) book analysis (four books were analysed) and concept analysis, (2) design of teaching materials, (3) standardisation of teaching materials using a modified BSNP assessment questionnaire, (4) revision and development of teaching materials, and (5) field testing of teaching materials and final revision. The teaching materials consist of features such as "To Remember", "Basic Understanding", "Chemical Concepts" and several pictures that serve as supplements to enhance the KGS, and features that increase knowledge and attract students' interest in the learning material, such as "Chemical Info", "Chemical News" and "Chemical Figures". In the teaching materials, there are "Sample Questions" and " Practice" to further train students' understanding. Based on the results of standardisation by material experts and media experts, the teaching materials go through the revision stage to produce teaching materials that are very suitable for use in learning. Then, field tests were conducted to obtain the reactions of teachers and students as users of the teaching materials, and the results showed that the teaching materials were very well used as learning resources and very interesting for students.

Keywords: Research and development, teaching materials in the form of electronic books, generic science skills, thermochemistry.

Abstract: Development of Teaching Materials in the Form of Electronic Books Integrated with Generic Science Skills in Chemical Equilibrium. *Pemilihan bahan ajar merupakan bagian penting dalam pembelajaran, oleh karena itu guru sekiranya dapat mengembangkan bahan ajar yang sesuai untuk upaya meningkatkan efektivitas proses pembelajaran. Maka dilakukan penelitian bertujuan menghasilkan bahan ajar berbentuk buku elektronik yang terintegrasi Keterampilan Generik Sains (KGS) untuk meningkatkan keterampilan berfikir tingkat tinggi peserta didik pada materi Kesetimbangan Kimia pada SMA kelas XI di sekolah menengah atas Swasta Laksamana Martadinata Medan melalui penelitian dan pengembangan atau (Research & Development, R&D) model 4D (Define, Design, Development, and Disseminate). Pengembangan bahan ajar dimulai dari (1) analisis buku (terdapat empat buku yang dianalisis) dan analisis*

konsep (2) perancangan bahan ajar, (3) standarisasi bahan ajar dengan menggunakan angket penilaian BSNP yang telah dimodifikasi, (4) revisi dan pengembangan bahan ajar), dan (5) uji coba lapangan bahan ajar dan tahap revisi akhir. Bahan ajar terdiri dari fitur-fitur seperti; "Untuk Diingat", "Pemahaman Dasar", "Konsep Kimia" dan beberapa gambar yang berfungsi sebagai tambahan untuk meningkatkan KGS dan fitur untuk menambah pengetahuan dan menarik minat peserta didik terhadap materi pembelajaran, seperti; "Info Kimia", "Warta Kimia", dan "Tokoh Kimia". Pada bahan ajar terdapat "Contoh Soal" dan "Mandiri Kimia" untuk lebih melatih pemahaman peserta didik. Berdasarkan hasil standarisasi oleh ahli materi dan ahli media, bahan ajar melalui tahap revisi untuk dihasilkan bahan ajar yang sangat layak digunakan dalam pembelajaran. Kemudian dilakukan ujicoba lapangan untuk memperoleh respon guru dan peserta didik sebagai pengguna bahan ajar dan didapatkan hasil bahan ajar sangat baik digunakan sebagai sumber belajar dan sangat menarik bagi peserta didik.

Kata Kunci : *Penelitian dan pengembangan, bahan ajar berupa buku elektronik, keterampilan generik sains, termokimia*

• INTRODUCTION

Education is a tool to optimize the individual potential of every member of society in a country. Quality education plays an important role in improving the quality of human resources, including in terms of spirituality, intelligence, character and skills. The government's efforts to improve the quality of education are carried out through improving the quality of the curriculum. Currently, the implementation of the 2013 curriculum is one of the efforts made in the education system in Indonesia. to improve the quality of learning. (Sham, 2017).

Muzamiroh in research cited by Sani (2013) states that efforts to improve the curriculum aim to create a national education system that is competitive and remains relevant to the changing times of interest. To implement the curriculum properly, support is needed in terms of procuring appropriate teaching materials, selection of material arrangements, student activities during learning, practicum activities, extracurricular activities outside of school, and the use of appropriate learning media. Various efforts have been made to improve the quality of the curriculum, one of which is the development of instructional media such as teaching materials, student worksheets (LKS), and evaluation questions.

One of the mandatory things for education is having facilities and infrastructure, such as; classroom equipment, learning media such as books and other learning resources, laboratory equipment, information technology equipment, study rooms, fields, school buildings and others (Megasari, 2014). The existence of limited school facilities and infrastructure will affect the learning process such as limited laboratories to support the chemistry learning process and limited learning media to support chemistry learning which also needs to be supported by technological advances.

The learning process is an activity that can influence students to achieve educational goals. In the current era, a student - *centered learning approach* is being developed. This approach emphasizes student involvement in the learning process. However, the chemistry learning process is still less effective because there are various factors that have an influence on it. One of them is the limited access of students to teaching materials and learning media which can affect their understanding of the material being taught.

Chemistry can be seen from two different perspectives, namely as a result (product) and as a process. A chemical perspective as a result involves an understanding of chemical facts, concepts, and principles. Meanwhile, the perspective of chemistry as a process

involves the skills and attitudes of researchers to develop knowledge (Rosidah, 2017). Based on this, learning chemistry does not only focus on theory (products), but also involves experiments (processes). Techniques that are in accordance with chemistry learning, which is: (1) learning chemistry with concept understanding, (2) from easy to difficult material, (3) using various memorization techniques, solving problems, mastering concepts, mastering chemical rules, solving problems in the laboratory, and (4) linking it to everyday life (Nurdyansyah, 2016). Chemical balance is one part of learning chemistry. Chemical equilibrium is defined as a reaction that takes place in two directions continuously until there is a chemical equilibrium between the reactants and products (Priyambodo, 2016). But chemical equilibrium is not only limited to reactants and products but also consists of concepts, facts and principles. Therefore, the use of instructional media and the teacher's role have great significance in increasing students' understanding in learning chemistry. Chemistry as a process also develops various student skills, including creative skills, process skills, and other higher order thinking skills. However, among all these skills, there are basic skills that are very important in science lessons, namely basic skills in science that are general and fundamental. (Izetbigovic, 2019).

There are factors that cause students to have difficulty in learning chemistry, namely external factors, namely the attitude of the teacher in the learning process, environmental factors, and ineffective learning time (Muderawan, 2019). One of the problems that is often faced by teachers in the learning process is selecting and selecting appropriate teaching materials (Nugraha, 2013). Teachers need to choose material that is relevant to learning objectives in order to help students achieve the expected competencies. Therefore, it is important for teachers to have a broad understanding of the various learning models and methods that can be used, old and new learning methods and strategies so that teachers can adapt to the material to be taught. Teachers carrying out the learning process must prepare learning tools such as syllabus, lesson plans, assessments, teaching materials, and learning media (Suharyari, 2021).

In learning chemistry, generic science skills play a very important role as the main foundation before using higher order thinking skills. Generic science skills enable students to solve science problems and learn science concepts. By mastering these generic science skills, students will experience ease in understanding chemical concepts. So, students need to have and develop generic science skills involving cognitive strategies that are connected to three main aspects, namely the cognitive, effective, and psychomotor dimensions (Martiningsih, 2018). In addition, generic science skills have a role as a general basis, flexible, and become a guide for students. to use higher order thinking skills (Suyitno, 2012). According to Brotosiswoyo in (Wijaya, 2019) There are nine signs of generic science skills that will be developed in students, and used in the learning process. There are nine kinds of generic science skills which include: direct observation, indirect observation, awareness of scale, use of symbolic language, application of logical frameworks, logical reasoning, understanding of causal laws, mathematical modeling, and ability to construct concepts.

Media and teaching materials are very important supporting factors in the learning process. Teaching materials, which are also often referred to as main elements, have a very significant role in conveying information and learning materials to students. in the learning process and become a core part of the overall learning process. According to Pannen, as cited in research by Herawati (2018), teaching materials refer to a collection

of learning materials that have been arranged. Teaching materials, both in written and non-written forms, are systematically arranged to create an environment that facilitates the learning process for students.

In learning activities in the field of Chemistry at Laksamana Martadinata Private High School Medan, the use of teaching materials is currently still limited, which indicates that students experience a shortage of learning resources. Teachers also face limitations in accessing teaching materials. Teaching materials currently used in the learning process still follow traditional methods and are less attractive to students. The impact of using conventional teaching materials is that teacher activities are more dominant and students participate less in the learning process because the number of listeners is far greater. Therefore, the competence to develop teaching materials properly needs to be mastered by teachers so that students have better learning resources to improve the quality of education. At least good teaching materials include learning instructions, competencies to be achieved, lesson content, supporting information, training, work instructions, evaluation, and responses to evaluation results (Yuberti, 2014).

The rapid development of technology in the 4.0 era provided significant assistance for teachers and students in obtaining new information from various sources. Like it or not, students and teachers are required to be fluent in using technology. Development of teaching materials in the form of electronic books By utilizing information and communication technology (ICT), teaching materials can be updated and presented in a more attractive way for students. is one way that teachers and students can do to overcome the limitations of school facilities, easily accessible with minimal costs. E-books refer to digital versions of textbooks, which can be accessed in a digital format. Electronic books also have a function as a learning environment that includes applications with multimedia databases that provide learning resources about the material contained in a book. (Restiyowati, 2012). Use of electronic books This teaching material can be used by students and teachers as a learning resource.

By considering the context previously described, the researcher intends to carry out a study on the development of learning materials. electronics that integrate generic science skills. The title of the research to be carried out is "Development of Teaching Materials in the Form of Electronic Books Integrated with Generic Science Skills in Chemical Equilibrium Materials for Class XI Senior High School ".

▪ METHOD

This research will be conducted in two locations, Medan State University and Senior High School Swasta Laksamana Martadinata Medan. This research will be conducted from December 2022 to February 2023.

The subjects of this research are lecturers as validators who will validate the e-book. The object of this research is an e-book integrated with science generic skills on chemical equilibrium material as teaching material. The resulting e-book was assessed by expert validators in the field of material and expert validators in the field of learning media. The validation process is in accordance with the standard assessment criteria set by the National Education Standards Agency (BSNP), the validation sheet is given to a chemistry lecturer. In addition, teacher and student responses were seen using an assessment questionnaire; consisting of 2 teachers and 10 students providing responses to electronic books based on limited trials.

This study used the research and development (R&D) method which is a process to develop new products or improve existing products, with measurable responsibility

(Sirate, 2017). This research follows the 4D model, which consists of the define stage, design stage, develop stage, and disseminate stage.

Data collection is the main aspect in this research with the aim of obtaining the required data and minimising errors and obstacles in this research. In this study, the data collection technique used a questionnaire. Questionnaires or questionnaires are given to experts, teachers and students. Questionnaires given to experts can be used to see whether teaching materials are feasible or not to use. Questionnaires given to teachers and students will be useful to see whether teaching materials are feasible as a learning resource and interesting for students.

▪ RESULTS AND DISCUSSION

This research was designed based on research and development (R&D) or Research & Development methods. This study adopts the 4D model which includes the define, design, development, and dissemination stages. Researchers will conduct a literature study, test Core Competency (KI) and Basic Competency (KD), and design an e-book that is integrated with generic science skills on chemical equilibrium material. researchers will obtain data from the validation of material and media experts, teacher responses and student responses to the teaching materials developed. In order to obtain the final product of teaching materials in the form of electronic books that integrate basic science skills on the topic of chemical equilibrium for class XI Senior High School.

At the definition stage, an analysis of high school level chemistry books was carried out. In the analysis stage for high school chemistry books, the researcher used four books (B1, B-2, B-3, and B-4) which are teaching materials that are generally used by teachers when teaching chemistry at the high school level. The list of books analyzed in this study can be found in Table 1.1 below:

Table 1. Identity of Literary Books

No	Title	Authors	Publisher	Year Published
1	Aktif Belajar Kimia Untuk SMA/MA Kelas XI	Erfan Priambodo	Dapartment of National Education Book Center	2009
2	Kimia SMA/MA Kelas XI	Shidiq Premono	Dapartment of National Education Book Center	2009
3	Memahami Kimia SMA/MA Untuk Kelas XI, Program Ilmu Pengetahuan Alam	Irvan Permana	Dapartment of National Education Book Center	2009
4	Buku Siswa Kimia Untuk SMA/MA Kelas XI Edisi 2016	Erfan Priambodo	Dapartment of National Education Book Center	2016

Based on the results of the analysis of the four books, there are also differences in each book in explaining the concept of chemical equilibrium, both in terms of subject matter and sub-material that are adapted to the chemical equilibrium syllabus. The results of the analysis can be seen from the feasibility analysis of the teaching materials. The book will go through a validation process by validators who are experts in the field of material and validators who are experts in the media. In addition, responses from teachers and students will be evaluated using a questionnaire. Questionnaires will be given to 10 students as respondents. provide responses to e-books based on a limited trial. The following chart shows the percentage of eligibility results:

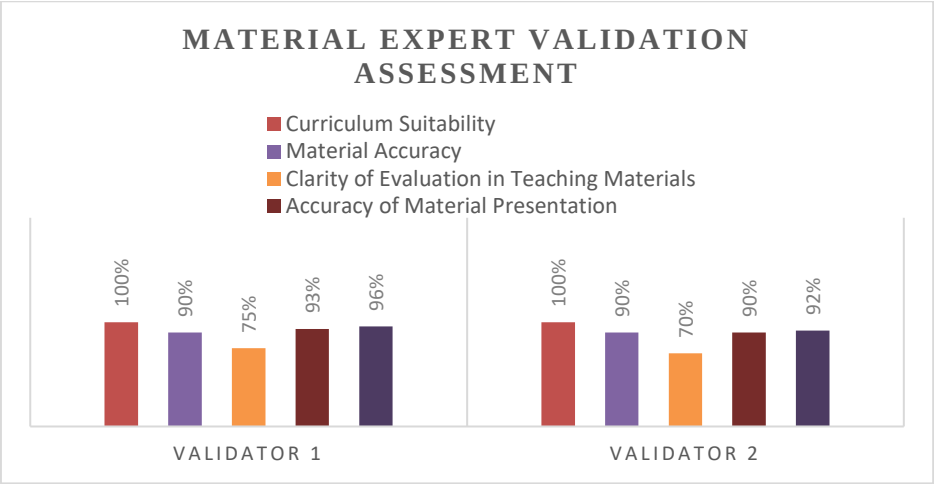

Figure 1. Material Expert Validator Assessment Graph

Based on the data shown in Figure 1 it can be concluded that the material validation results show an average percentage of 90%. This indicates that the material contained in the electronic book as a learning resource has been declared feasible or according to the expected standards. has earned a high eligibility rate. integrated with generic science skills on this chemical equilibrium material "Very Appropriate" based on BSNP criteria.

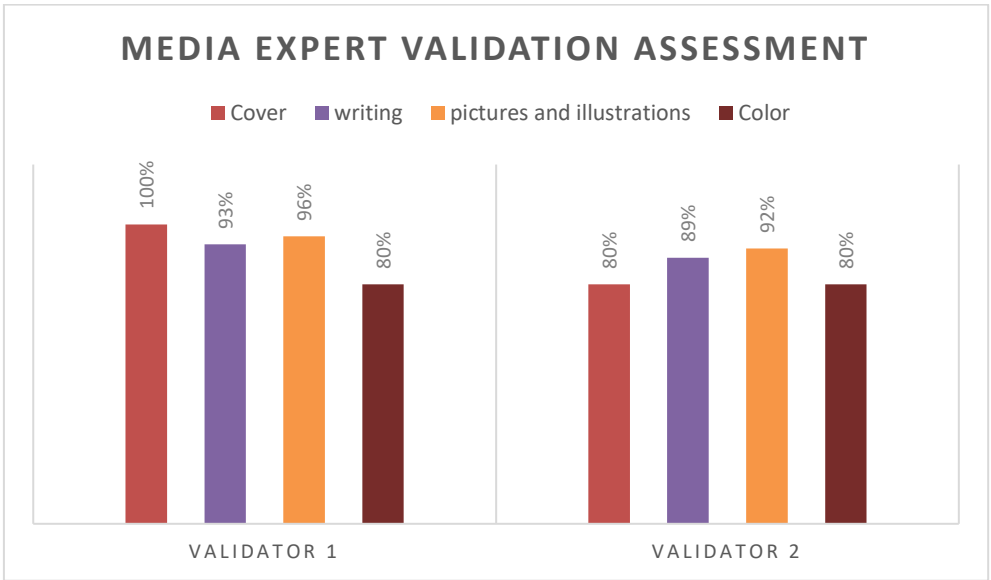

Figure 2 Graph of Media Expert Validation Assessment

Based on the information shown in Figure 2, it can be concluded that the results of the evaluation of learning media show an average percentage of 89%. This shows that the integration of material in electronic books used as teaching materials has been

successfully assessed positively and meets the established criteria. as a teaching material has been successful in the aspect of appropriate and effective use of media. with generic science skills on chemical equilibrium material is "Right" based on BSNP criteria.

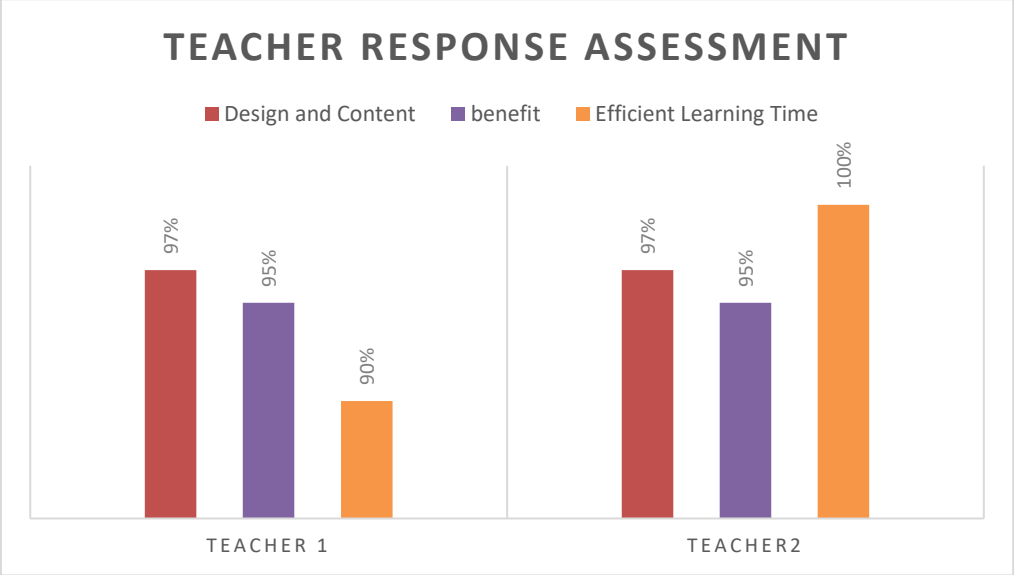

Figure 3. Teacher Response Assessment Graph

Based on Figure 3, it can be seen that the average percentage of teacher responses is 96%. This indicates that the electronic book that has been developed meets the expected quality standards. to be used as a source of teaching materials for class XI SMA on chemical equilibrium material.

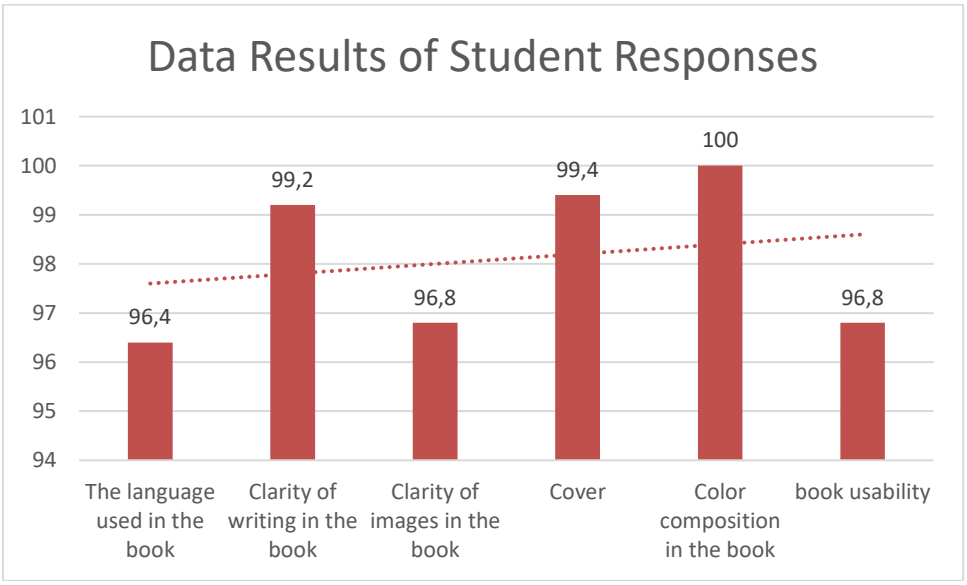

Figure 4. Graph of Student Response Results

Based on Figure 4, it can be seen that students gave positive responses to the e-book that had been developed. This can be seen from the average percentage of 98.1%.

Therefore, it can be concluded that e-books that are integrated with generic science skills on chemical equilibrium material get positive responses from students and are considered effective as learning resources.

▪ CONCLUSION

Within the framework of this research, several conclusions can be drawn:

The development of teaching materials for Chemical Equilibrium integrated with Science Generic Skills (KGS) can be carried out development research (Research & Development, R&D) with the 4D model (Define, Design, Development, and Disseminate). First, the definition stage, through the stage of book analysis as literature for developing teaching materials and concept analysis to study core competencies, basic competencies, achievement indicators and learning objectives. The design stage, this stage goes through the process of designing and selecting the format of the material, then the teaching material is obtained in the form of an electronic book integrated with science generic skills on chemical equilibrium material. The teaching material development stage, after the teaching material draft is made, the teaching material will be validated by experts to find out whether the teaching material is feasible or not in its use. Feedback and criticism from experts become a reference for researchers to make teaching materials better. The dissemination stage, the field test stage, is indicated by teaching materials given to teachers and students. The teaching materials consist of features such as; "To Remember", "Basic Understanding", "Chemical Concepts" and several images that serve as additions to improve KGS and features to increase knowledge and interest students in learning materials, such as; "Chemical Info", "Chemical News", and "Chemical Figures". According to the assessment of material and media experts, teaching materials are very feasible to use, with an assessment range of 89-90% From the field trial, the response of teachers and students was 96% and 98.1%, respectively, so it can be concluded that teaching materials in the form of electronic books integrated with KGS on Chemical Equilibrium material are very feasible to use as textbooks and very attractive to students.

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