Development of Process Oriented Guided Inquiry Learning (POGIL) Model as Integrated Chemistry Teaching Materials on First Grade Senior High School

Asri Safira Fadilla[1] , Iis Siti Jahro[2] , Moondra Zubir[3]

{asrisafira97@gmail.com,[1] jahrostiis@yahoo.com,[2] moondrazubir@unimed.ac.id [3]}

Chemistry Education Postgraduate Program, Universitas Negeri Medan[1], Department of Chemistry Education Postgraduate Program, Universitas Negeri Medan[2,3]

Abstract. Integrated Chemistry Teaching Materials has been developed as POGIL (Process Oriented Guided Inquiry Learning) model on first grade senior high school. The development research method was used restricted ADDIE including analysis, design, and development stages. There are 6 validators who assess developed teaching materials consisting of 3 lecturers and 3 teachers . The assessment results of all validators show an average score are 3.53; 3.52; 3.62 and 3.64 respectively for the eligibility aspects of the content, language, presentation and graphics with feasible or valid criteria. It considere that POGIL model of integrated chemistry teaching materials is feasible using for the students.

Keywords: Teaching Material, POGIL (Process Oriented Guided Inquiry Learning), Chemistry.

1 Introduction

Teaching materials are information, tools/media used by teachers to carry out learning, including creating an atmosphere that encourages students to learn. educators need teaching materials as a guide in learning activities [1]. Teaching materials are prepared with the aim of providing materials for learning in accordance with the demands of the applicable curriculum by considering the needs of students which include the characteristics and environment of students. The development of teaching materials is very important for teachers to be able to carry out harmonious, quality and dignified learning. The development of teaching materials is carried out by the teacher by paying attention to various rules, principles and rules for developing teaching materials. One thing that teachers can do in developing teaching materials is to integrate teaching materials with the POGIL (Process Oriented Guided Inquiry Learning) learning model. The POGIL learning model is a process-oriented learning model for students [2]. There are 6 principles in developing teaching materials, namely: 1). Teaching materials must be according to the curriculum used, (2). Teaching materials must be contextual, (3). Teaching materials must be able to generate motivation to learn in students. (4) Teaching materials allow students to focus more. (5). Teaching materials encourage students to develop

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their learning skills. (6). Teaching materials must make students understand the material from difficult to easy. Teaching materials are prepared with the aim of providing materials for learning according to the demands of the applicable curriculum by considering the needs of students which include the characteristics and environment of students. The development of teaching materials is very important for teachers to be able to carry out harmonious, quality and dignified learning. The development of teaching materials is carried out by the teacher by paying attention to various rules, principles and rules for developing teaching materials. One thing that teachers can do in developing teaching materials is to integrate teaching materials with the POGIL (Process Oriented Guided Inquiry Learning) learning model. The POGIL learning model is a process-oriented learning model for students, so thus ncourages students to process information and knowledge and can assist students in developing understanding by applying the learning cycle in guided inquiry activities [3]. There are 4 stages in the POGIL learning model, namely: (1) orientation stage, (2) exploration stage, (3) concept formation stage, and (4) application stage. These stages show that the POGIL learning model focuses on process components which include how to receive and produce knowledge [4]. POGIL learning increases students' perceptions about the importance of group work, about the importance of colleagues in helping each other to understand concepts. The tasks and roles of members of the heterogeneous groups formed in POGIL's activities are aimed at increasing student learning outcomes and motivation [5]. Students learn to use modules that have been integrated with POGIL to be more coordinated in building and understanding concepts well. POGIL activities not only increase student interaction with the material, but also students with friends, students and teachers, increasing student engagement with students [6]. Most of the material in chemistry is abstract and complex so tchemistry is seen as a difficult subject. The chemistry material that is difficult for students to understand is the chemistry material in class X semester 2 [7]. This is evident because, the chemistry material for class X semester 2 contains many concepts and even formulas that make it difficult for students to understand the material. but also students with friends, students with teachers, increasing student engagement with students.

2 Method

This type of research uses development research or research and development (R&D). The development model used is the ADDIE model (Analysis, Development, Design, Implementation, and Evaluation). However, this research is limited to only 3 stages, namely (Analysis, Design, and Development). The POGIL model integrated teaching materials were validated by 3 expert validator, namely unimed chemistry lecturers and 3 chemistry teachers.

3 Result and Discussion

Before carrying out the development of teaching materials, in the initial stage the chemistry books for class X semester II in schools were analyzed. The following is an explanation of the research phase

3.1 Analysis

At this stage the books use in schools. Book analysis was carried out using the BSNP feasibility questionnaire. In the BSNP feasibility questionnaire, here are aspects one of which is the feasibility aspect that requires improvement. At this stage, an assessment of content standards was carried out, including an assessment of Core Competencies (KI) and Basic Competencies (KD) as a reference for developing guidelines for chemistry teaching materials in this study. The results of the assessment at this stage are an overview of the minimum competencies that must be possessed by students as well as an overview of chemistry topics in class X high school that can be designed for learning.

At this stage the researcher analyzed the teaching materials in the school. The teaching materials analyzed were in the form of student books used in schools for teaching and learning activities. Two teaching materials were analyzed. The results of the analysis of teaching materials used in schools, which can be seen in the table below.

Table 1. Preliminary analysis book 1 and book 2

Eligibility Level	Book 1	Book 2	Expansion plan
Eligibility Of Content	There are two concept maps on electrolyte and non-electrolyte solutions with redox reactions in one chapter. And there are no keywords in the concept map	There are no concept maps and keywords that will be discussed in each chapter	There are two concept maps on electrolyte and non-electrolyte solutions with redox reaction where the concept maps are located in diffrent chapters. And there are keywords in the concept map.
	There is no evaluation of ech experimentl activity such as the resukts and disucussions as well as related wuestions that were put into practice	-	There is an evaluation of each experimental activity such as results and discussion as well as related questions that are put into practice
	The laws chapter-basic laws of chemistry is separate from the stoichiometry chapter	-	The laws-basic laws of chemistry chapter is not separate from the stoichiometry chapter
	There are no learning objectives in each chapter	There are no learning objectives in each chapter	There are learning objectives in each chapter
	Not integrated with the learning model	Not integrated with the learning model	Integrated with the POGIL learning model
Language suitability	Use of language that	Use of language that	Language that is

	is less communicative	is less communicative	communicative so that students can understand it
Suitability of Presentation	The chapters on electrolyte and non-electrolyte solutions, redox reactions, and compound nomenclature are combined in one chapter	The chapters on electrolyte and non-electrolyte solutions, redox reactions, and compound nomenclature are combined in one chapter	The chapter on electrolyte and non-electrolyte solutions is separate from the chapter on redox reactions and compound nomenclature.

3.2 Design

This stage desgins teaching materials that have previously been analyzed. At this stage, teaching materials are created based on the BSNP analysis reference sources that have been analyzed in the previous stages. The material used for research is class X even semester redox reaction material as well as designing the draft teaching materials that will be used. The teaching materials integrated with the POGIL model hava different spesifications from the teaching materials avalaible in schools. Where in this book it will be integrated with the POGIL model which has several syntaxes, such as: orientation, exploration, concept formation, and application. Designed with a very simple but elegant cover and there are 3 authors inside. There is a foreword and table of contents to make it easier to find out what material is contained in the book. In each chapter there is a concept map, learning ojectives, and a little material that encourages students to ask questions. In each chapter there are students worksheets and competency test to encourage students to be more creative and evaluate the material in that chapter. Integration of the POGIL model is made in each sub-chapter to make students think more critically.
Teaching materials use a margin size format of 16,5 cm x 24 cm with top, right, and bottom margins of 2.5 cm while the left is 2.5 cm. The type of writing (font) used by times new roman is with different font sizes. The title uses font size 14, while the material description uses size 12. The spacing between multiple lines is 1,15 spaces.

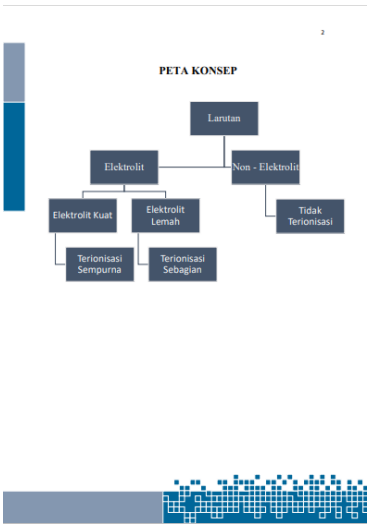
3.3 Development Stage

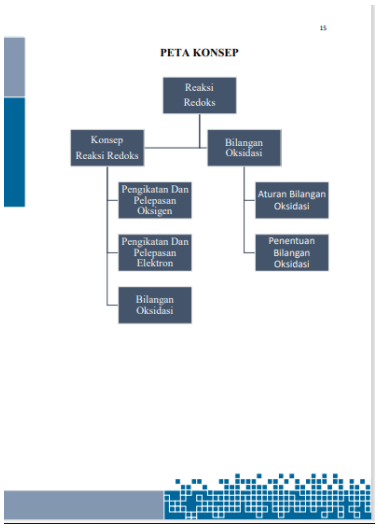
At this stage, we are developing integrated chemistry teaching materials for the POGIL model based on things that have been designed in the previous stage. There are 2 stages in development, namely: the product stage of teaching material development and the validation stage.

3.3.1 Product Developmet

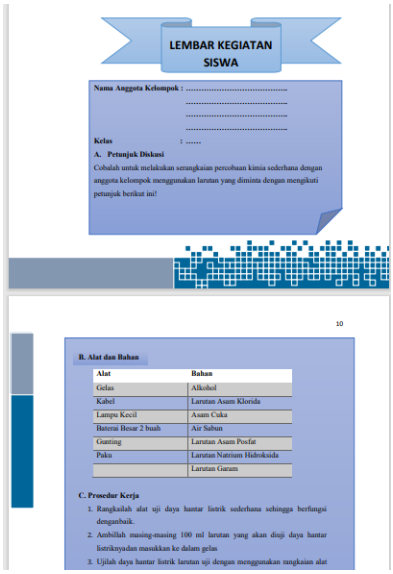
In accordance with the design, at the teaching material development stage the POGIL model has been integrated. The results of the development plan based on table 1 are as follows:

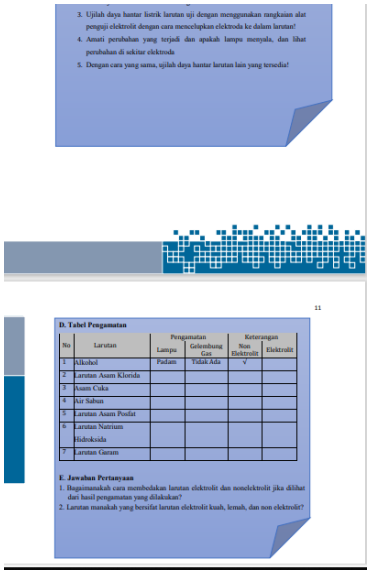
1. There are two different concept maps on electrolyte & non-electrolyte solution material and redox reaction material, where the two materials are in different chapters.



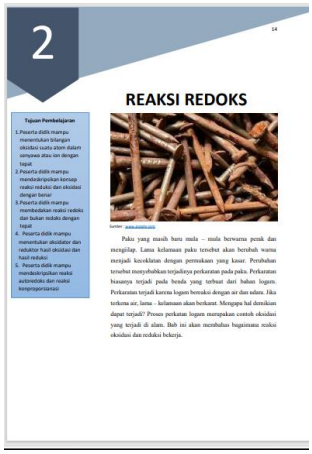


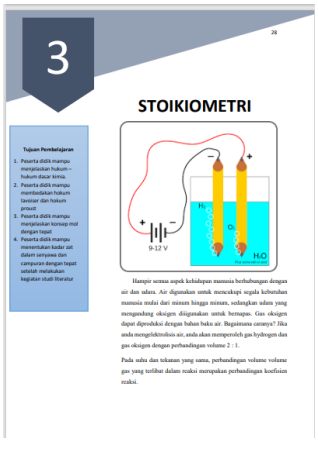
2. There is an evaluation structure for each experimental activity such as results and discussion as well as related questions that are put into practice.





3. There are learning objectives in each chapter





4. Integrated with POGIL. There are 4 syntaxes in the POGIL learning model, namely: orientation, exploration, concept formation, and application. This syntax is integrated into each sub-chapter. The Orientation stage contains descriptions of the material as a reference for students to go to the next stage. The following 3 stages are presented in the

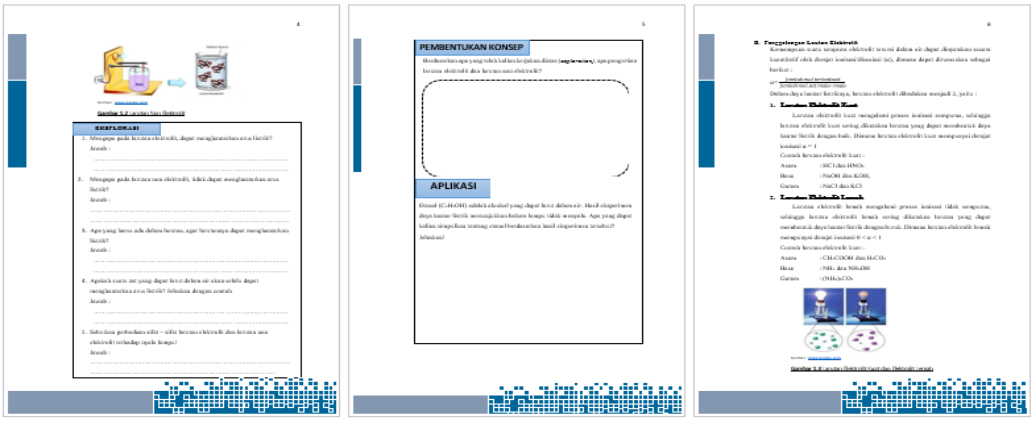


Figure 1. Display of the contents of POGIL integrated teaching materials

3.3.2 Validation Stage

The teaching material products that have been developed are then validated by 6 validators. . Validation was carried out using BSNP eligibility criteria, namely: appropriateness of content, language, presentation and graphics. Below are presented the validation results for each aspect.

1. Content Eligibility

The feasibility aspect of the content consists of 4 components including: the suitability of the material with KD, the accuracy of the material, the updating of the material, and encouraging curiosity. The results of the content feasibility aspect which have been validated by 3 expert lecturers and 3 chemistry teachers can be seen in Figure 2.

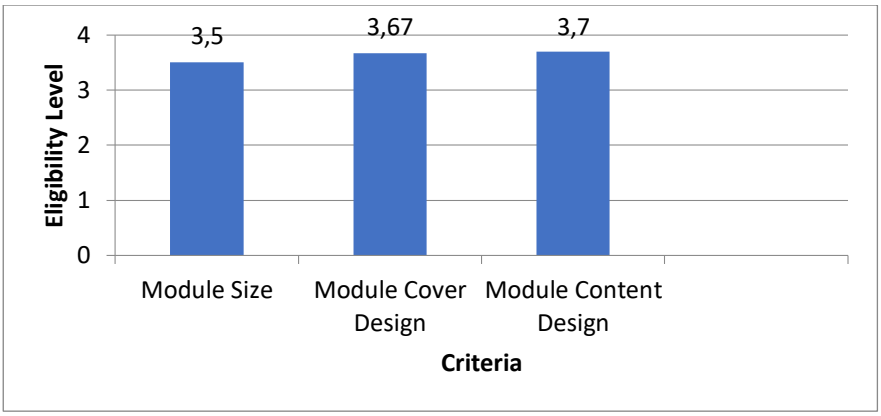


Figure 2. Graph of Feasibility Analysis Results of Developed Teaching Materials

Based on the results of the analysis above, the component of material suitability with Basic Competence and Material Updating has the highest average value, namely: 3.8. Meanwhile, the component of encouraging curiosity has the lowest average, namely: 3.2. All components have valid criteria without needing to be revised. So, the teaching materials that have been developed are feasible to use.

2. Language Eligibility

The language feasibility aspect consists of 4 components include. In accordance with the development of students, the clarity of sentences and the level of readability, aspects of assessment, and aspects of the use of language, terms and symbols. The results of the language feasibility aspect which have been validated by 3 expert lecturers and 3 chemistry teachers can be seen in Figure 3

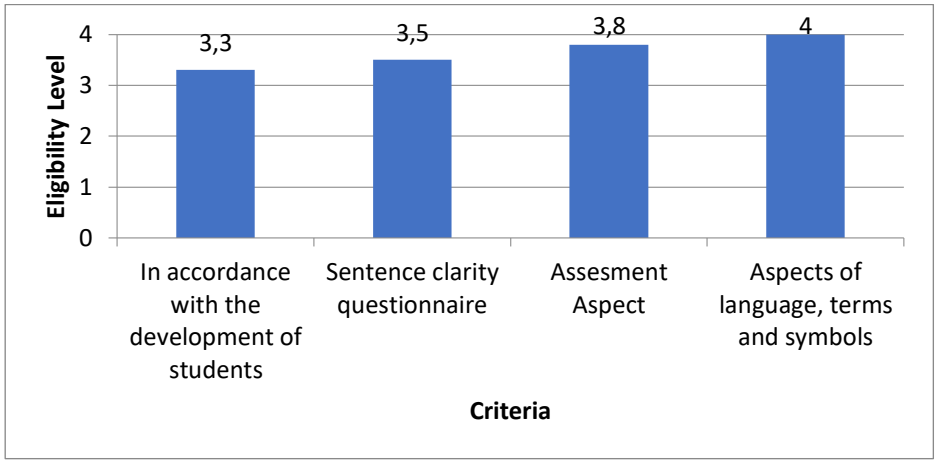


Figure 3. Graph of the Feasibility Analysis Results of Language Teaching Materials Developed

Based on the results of the analysis above, the component aspects of language use, terms and symbols have the highest average value, namely: 34.0. Meanwhile, the component according to the development of students has the lowest average, namely: 3.3. All components have valid criteria without needing to be revised. So, the teaching materials that have been developed are feasible to use.

3. Adequacy of Presentation

The presentation feasibility aspect consists of 4 components including: Presentation techniques, Presentation Support Aspects of teaching module presentation, and evaluation. The results from the feasibility aspect of the presentation which have been validated by 3 expert lecturers and 3 chemistry teachers can be seen in Figure 4.

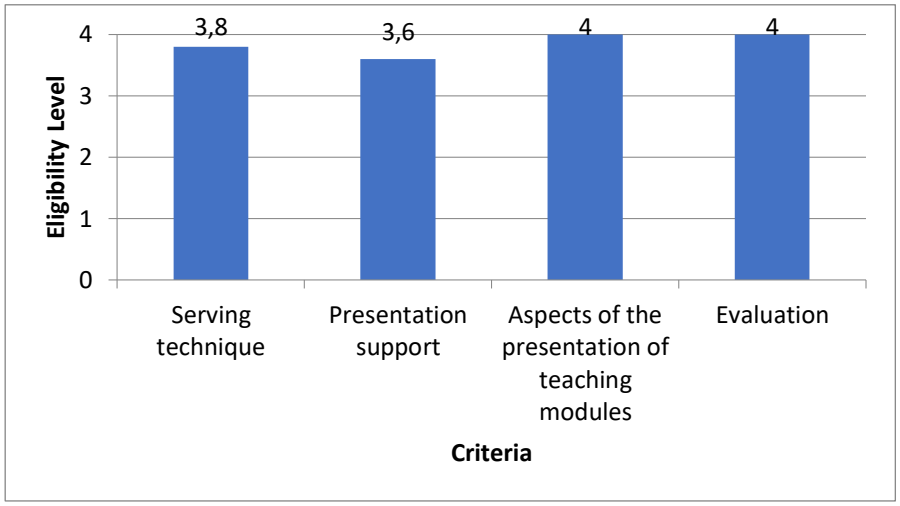


Figure 4. Graph of Feasibility Analysis Results for Presentation of Teaching Materials Developed

Based on the results of the analysis above, the components of the teaching and evaluation module presentation aspect have the highest average value, namely: 4.0. Meanwhile, the baking support component has the lowest average, namely: 3.6. All components have valid criteria without needing to be revised. So, the teaching materials that have been developed are feasible to use.

3. Graphic Eligibility

The graphic feasibility aspect consists of 3 components include: module size, module cover design, and module content design. The results of the graphical feasibility aspect which have been validated by 3 expert lecturers and 3 chemistry teachers can be seen in Figure 5.

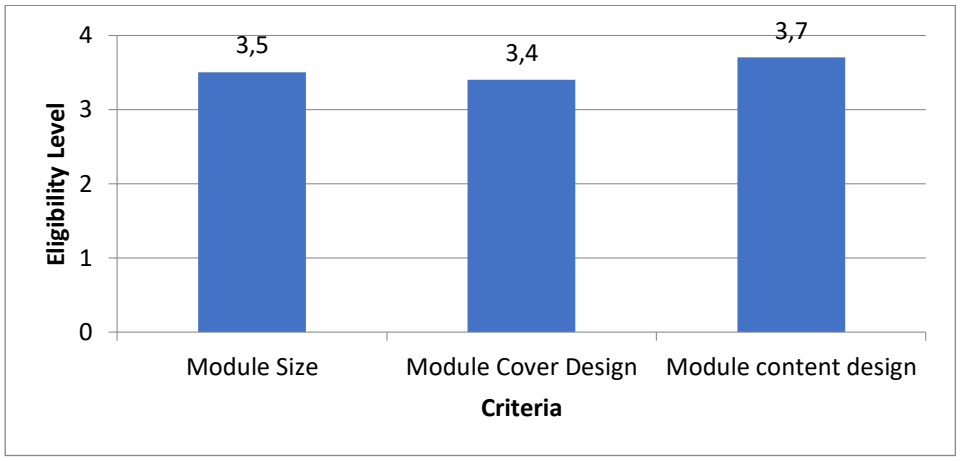


Figure 5. Graph of Feasibility Analysis Results of Developed Teaching Material Graphics.

Based on the results of the analysis above, the module content design aspect component has the highest average value, namely: 3.7 Meanwhile, the module cover design component has the lowest average, namely: 3.4. All components have valid criteria without needing to be revised. So, the teaching materials that have been developed are feasible to used.

4 Conclusion

Based on the results of the data analysis, the level of feasibility of POGIL integrated teaching materials developed based on BSNP questionnaire and validated by 3 expert lecturer and 3 chemistry teacher with an average of 3,65 with a valid category without needing to be revised and suitable for use in even semester X class chemistry learning.

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