The development of Chemistry Teaching Guide (CTG) on electrolyte solution and redox reaction based on scientific inquiry

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Abstract. The purpose of this study is to develop a chemistry teaching guide (CTG) for electrolyte solution and redox reaction based on scientific inquiry and find out its quality through the assessment of high school chemistry teachers. The choice of electrolyte solution and redox reaction material because this material is material that is easily developed into a scientific inquiry-based activity. This is research and development (R&D). The CTG was assessed by high school chemistry teachers who had taught the material for at least 2 years. The quality of the results of development is reviewed from the 5 assessment components, namely content, presentation, language, implementation, and display. The results of this study are that CTG based on scientific inquiry has been developed. The quality of the CTG is Very Good in terms of the results of the chemistry teachers assessment. Thus, CTG is feasible to be used by teachers as a guide in learning electrolyte solution and redox reactions based on scientific inquiry.

1. Introduction
The success of education depends on the education system developed by the country. One component is the curriculum. The curriculum becomes an important reference in ongoing education, including Indonesia which develops the curriculum. Starting from the draft Competency-Based Curriculum (KBK) in 2004 which was later refined to an Education Unit Level Curriculum (KTSP) in 2006, in 2013 a new curriculum based on scientific inquiry, namely the 2013 Curriculum began to be developed, and starting the 2017 school year developed the 2013 Curriculum revision or National Curriculum. Success in curriculum implementation can be seen from the people involved, the programs, and the process [1]. One of the people involved in implementing curriculum in the classroom is the teacher. The teacher became a facilitator in the 2013 curriculum learning process. Teacher mental readiness is one of the obstacles in implementing the curriculum in schools. Mental teachers must be prepared for the implementation of the curriculum and the achievement of objectives. The teacher's mental readiness is one of the obstacles in implementing the curriculum at school [2]. The curriculum change are indeed good to keep abreast of the times, but this change should also pay attention to other things related to the implementation of learning in schools, for example, the ability of teachers, existing facilities and infrastructure, and so on.
The 2013 curriculum is a curriculum designed using a student-centered learning based model. Student-centered is more desirable for students in the learning process [3]. This is because students become active in finding a concept in the subject matter of a lesson and there is an innovation from the teacher in the learning process. The new curriculum program seeks to introduce several innovative approaches and methods to improve the history of education [4]. Learning activities undertaken are activities that make students more active and easier to capture the material presented. However, the majority of teachers do not understand the approaches and learning models that are in line with the 2013 Curriculum [5]. Many teachers who experience difficulty in each learning using different models. As a result, the model and approach used is the usual learning model, namely by using lectures in each of its learning.

Chemistry is a subdivision of science that studies chemical reactions in life. Learning chemistry requires a lot of time for all material to be conveyed. Including redox reaction and electrolyte solutions. This material has a limited time of learning, but the material is delivered a lot. The teacher must be smart in organizing learning so that sufficient learning time is used. This learning arrangement using the right model and approach. The accuracy of the selection of models and approaches makes learning run smoothly. For this reason, teachers must understand the appropriate models and approaches in implementing the 2013 curriculum.

From this reason, it is necessary to make efforts in understanding teachers regarding the implementation of the 2013 curriculum in learning. One of these efforts is the creation of a teacher's manual that guides teachers in conducting learning, specifically redox reaction materials and electrolyte solutions.

2. Methods
This research belongs to research and development (R&D) in the field of education. The development model used is the adaptation and collaboration of the Borg and Gall research and development model and the learning development design of Dick and Carey [6,7]. In this study, Chemistry Teaching Guide produced material of Electrolyte Solutions and Redox Reactions based on Scientific Inquiry.

The development procedure used is a procedure that has been simplified into 5 main steps consisting of the analysis phase, the planning stage, the implementation stage of the development, the revision stage, and the assessment stage. These five stages are adjusted to the needs of this study. The analysis phase includes an analysis of the needs, curriculum, goals, and objectives of the product being developed. The planning stage includes determining the software used, gathering references, determining media experts, material experts, peer reviewers, and reviewers. Peer reviewers are chosen from peers who understand material and development research. While reviewers are selected from high school chemistry teachers who have taught material. The stage of development includes the manufacture of products, instrument validation, and consulting supervisors. The revision stage includes a review by media and material experts, peer reviewer reviews, and product revisions. The assessment phase includes the assessment and review of the reviewer, as well as the analysis of the assessment results.

Data collected in the form of qualitative and quantitative data. The instrument used for qualitative data was a media expert review sheet, material experts, peer reviewers and reviewers. Qualitative data in the form of criticism and suggestions are used to revise the product being developed. While quantitative data in the form of assessments from reviewers consisting of 5 aspects with 25 points of assessment [8-10]. These five aspects are content, presentation, language, implementation and display. Grading points in it are adjusted to the product produced.

The results of the average rating are then converted into the form of product quality with criteria as follows [11]:
Table 1. Criteria of product quality.

| Guidelines                  | Range of scores | Category      |
|-----------------------------|-----------------|---------------|
| $X \geq (\mu + 1.5\sigma)$ | $X \geq 3.25$   | Very Good     |
| $(\mu + 0.5\sigma) \leq X < (\mu + 1.5\sigma)$ | $2.75 \leq X < 3.25$ | Good         |
| $(\mu - 0.5\sigma) \leq X < (\mu + 0.5\sigma)$ | $2.25 \leq X < 2.75$ | Adequate     |
| $(\mu - 1.5\sigma) \leq X < (\mu - 0.5\sigma)$ | $1.75 \leq X < 2.25$ | Not Good     |
| $X < (\mu - 1.5\sigma)$   | $X < 1.75$      | Very Not Good |

3. Results and discussion
This development research resulted in a product in the form of Chemistry Teaching Guide material for electrolyte solution and redox reactions. This product is in the form of a full-color printed book with 80 gram HVS paper size B5 (17.6 x 25) consisting of 153 pages and covers. This product was produced through 5 stages of development. In the first stage or stage of needs analysis, researchers look for and analyze national journals and national journals about teacher's books. The results of this analysis are that teacher books are rarely circulated. Moreover, teacher books that use the 2013 curriculum are still very rare. A curriculum that instills scientific inquiry in learning still leaves teachers confused in learning activities. This is supported by previous research that many teachers do not understand the approach to learning in 2013 [5]. This book is designed using the 2013 Curriculum and learning activities in it are based on scientific inquiry. Learning like this brings benefits to students, one of which is to make students active in learning. Previous research states that inquiry activities will be beneficial for students and good relationships will be formed with these students [12].

The next stage is the planning stage. This CTG development uses CorelDrawX7 software for the design section and Microsoft Word to write the contents of this CTG. The selection of peer reviewers and reviewers is based on their ability to understand the contents and appearance of a good book. The third stage is the development stage. At this stage, the CTG development is done by using the software. CTG products that have been completed at this stage of development are then given to material experts and media experts to review these CTG products. Material experts for the content part, while media experts for display and design. The results of this review as a reference to make revisions of the products that have been developed. The results of the completed revision are then given to the peer reviewer to review the product that has been developed. Their input is then used to revise this CTG product. This stage is a revision stage. The following is the appearance of the product after the revision process.

Figure 1. Cover of chemistry teaching guide.
The next step is the assessment by the high school chemistry reviewer or teacher. Teachers are chosen based on their experience teaching electrolyte solution materials and redox reactions. The results of the assessment from this reviewer can be seen in the graph below.

![Figure 2. Content of chemistry teaching guide.](image1)

Figure 2. Content of chemistry teaching guide.

The figure above shows that the average score per each aspect of the assessment is not too far from the maximum score.

![Figure 3. Comparison of average scores with maximum scores in all aspect.](image2)

Figure 3. Comparison of average scores with maximum scores in all aspect.

The figure above shows that the average score per each aspect of the assessment is not too far from the maximum score.
In the aspect of the quality of content, there are 6 points of assessment. These six points get an average score of between 4.6 and 4.4. An average score of 4.4 is found in points 3 and 6, which is the material used by current conditions or scientific information and the material presented is related to daily life. This CTG book is equipped with illustrations of events in daily life, for example, the oxidation of sliced potatoes and the corrosion of iron in the open air. Also, there are solutions in everyday life that can conduct electricity. Teachers must be able to provide a concrete realization of a given theory [13]. Another point in the quality of content is that it can support the achievement of national education goals, following existing realities, not in conflict with the prevailing laws and regulations in Indonesia, and sufficient to develop the competence of teaching staff. These four points get an average score of 4.6. CTG is developed based on the National Curriculum in Indonesia, specifically Chemistry subjects. With this, the product developed can support the achievement of national education goals, more specifically the learning objectives of electrolyte solution and redox reactions. The material presented in the CTG is adjusted to the reality, for example, it is the concept of an electrolyte solution that can indeed turn on the indicator lights and produce air bubbles. While the items do not conflict with statutory regulations, the material contained in the CTG is adjusted to the existing rules, so that in terms of the learning steps it will not conflict with laws in Indonesia. This CTG material can be used in developing the competence of teaching staff in teaching electrolyte solution and redox reaction materials. This is because in CTG there are inquiry-based learning steps that help teachers to do active learning in the classroom. The creativity and new thinking of the teacher can develop the curriculum in learning [13].

There are 5 points in the presentation aspect. The highest average score of items in the presentation aspect is to encourage students to be active in learning and be able to conclude learning material. CTG is designed by carrying out the National Curriculum which emphasizes the activeness of students in the learning process. This is implemented in the lesson plans and learning steps in the CTG. With this, CTG can guide teachers to make the class act in their learning. The next point with an average score of 4.4 is that the items are easily understood, straightforward, and coherent. The presentation in CTG is adjusted to the order of learning, including lesson plans, learning scenarios, teaching materials, LKPD, assessment instruments (attitudes, skills, and knowledge) as well as cognitive test questions. All of these components are components needed by the teacher in teaching. The next item that gets an average score of 4.2 is the presentation that can foster curiosity. Presentation of material in this CTG can trigger students' thoughts to ask the teacher and make learning more effective. The next point that gets point 4 is the presentation of material can develop character, academic skills, innovation and creativity abilities and evaluation questions by the ability of students. The material developed in this CTG helps teachers to develop students' thinking so that students can innovate and be creative according to the material available. The evaluation questions developed in the CTG are adjusted to the conditions of students who are new to chemistry. This evaluation problem is adjusted to the achievement indicators that have been determined at the beginning. The presentation process in the inquiry approach requires students to be active in learning or the learning is student-centered. The activeness of these students will be seen cognitive, affective and psychomotor. These three aspects are the reference in the assessment of students in the classroom. This is consistent with previous research that the center of learning is students, cognitive and affective experience becomes a guide in all decisions [14].
In the aspect of language, there are 5 grading points and 4 of them get an average score of 4.4. The use of the term in CTG is consistent from beginning to end, including reduction, oxidation, reducing agents, oxidizing agents, electrolytes, and non-electrolytes. These terms are terms in chemistry that are never used in everyday conversation. The sentences used in this CTG do not cause multiple meanings. The use of this sentence is considered because many users will later read this CTG. The spelling and grammar used is good and correct and does not contain sara. It aims to avoid offending those who read this book. The choice of words and punctuation in CTG is right so as not to cause confusion and is easily understood by the reader. The use of sentences in CTG is already interactive, but some parts are not.

The implementation aspect which consists of 6 points that get an average score of more than 4. The assessment instruments developed can measure 3 main aspects, namely knowledge, attitudes, and knowledge. These instruments are developed from existing basic competencies and indicators of competency achievement. This instrument adapts to the material developed. The skills instrument is used when there are practicum activities or group discussions, the attitude instrument is used flexibly according to the attitude that will be developed in the learning, and the instrument of knowledge adapts to the material available. In addition to the instruments, there are also assessment instructions that the teacher finds easy to understand, precise and clear. These results are in accordance with previous studies, tests and exercises in a media can be used to measure the ability of students [9]. Furthermore, inquiry-based learning scenarios presented clearly and easily to be implemented in the learning process. This scenario is based on a curriculum that directs students to be actively involved in learning. Learning approaches and methods are used in accordance with those recommended by the curriculum itself. While the instructional media are suggested to be able to support the inquiry process in the learning process. In the inquiry process, the teacher not only explains directly but uses the media so that students are more interested in learning and not feel bored.

In the display aspect, there are 3 item with 1 point score getting an average score of 4.2 and other items getting an average score of 4.6. The image used in this CTG is proportional to the page space and can support the inquiry process in learning. These images are taken from the internet and also photographs directly so that students can understand the existing images. While the size, type and colour of the letters used meet the readability requirements. This has been applied to teachers of various ages and they can read this CTG book well. The layout of the images and letters are arranged attractively so that readers do not feel bored. In accordance with previous research that the illustrations shown in a media must be clear and effective so that readers can understand these illustrations [9,10].

4. Conclusion
From the description above, it can be concluded that the chemistry teaching guide has been developed using 5 main stages, namely: the analysis phase, the planning stage, the development stage, the revision stage, and the assessment stage. This step is tailored to the product to be developed.
This book has a very good quality in terms of high school chemistry teacher assessment. The evaluation aspects are content, presentation, language, implementation and display. This category shows that CTG is suitable for use in the learning process at school and can be used as a textbook companion book. The development of CTG for other materials must continue for other materials. The aim is that scientific learning can be carried out by teachers in schools, especially in chemistry.

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