The e-module development of reaction rate based on guided inquiry as independent teaching materials

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Abstract. E-module reaction rate based guided inquiry has been developed using the Kvisoft flipbook maker. The e-module is developed using the Plomp development model which consists of three phases namely, the initial investigation phase, the prototype making phase, and the assessment phase. The results of the material validation obtained an average percentage for the content aspects, presentation aspects, language aspects, and graphics aspects are 87.46%, 86.63%, 95.80%, and 81.5% with a very valid category. While the result of media validation obtained an average percentage for the cover design aspect, the content design aspect and the display aspect are 100%, 97.80%, and 85.6% with a very valid category. The result of the user response test obtained average percentages are 88.34% and 86.25% with a very good category. Based on the result of the validation and user response test can be concluded that the e-module reaction rate based guided inquiry is feasible to be used in the chemistry learning process as independent teaching material.

1. Introduction

Learning in the 21st-century students are required to be able to develop skills and abilities in mastering information and communication technology so that they can face the challenges of globalization in the future [1]. At the same time, the government is trying to improve the quality of education [2] where the target of education in the 21st century as a century of information technology has traditionally shifted to the knowledge that requires thinking skills and ways of thinking [3].

Along with the development of technology and information and the demands of 21st-century learning and the 2013 curriculum, teachers must utilize IT in learning, especially chemistry learning. One form of IT utilization in learning is to implement an e-learning based teaching material. I the term "e" or the abbreviation of electronics in e-learning is used as a term for all technologies used to support teaching efforts through internet electronic technology [4].
The application of e-learning in learning will provide many advantages, two of which are the main ones are to increase the effectiveness and flexibility of learning [5]. One of the e-learning based teaching materials that can be used to support the learning process is the development of modules that are packaged in electronic form or e-modules. E-module is an ICT-based module, its advantages compared to printed modules are its interactive nature makes it easy to navigate, allows displaying / loading images, audio, video, and animation and is equipped with formative tests/quizzes that enable automatic feedback immediately [5]. Also, the e-module is defined as a set of systematically compiled digital or non-print teaching media that is used for independent learning in electronic format [6, 7].

Also, in the 21st-century learning and 2013 curriculum, students are expected to discover their concepts of the material being studied. The learning model that involves students to discover for themselves a material concept is a guided inquiry learning model [8]. The guided inquiry learning model is a series of learning activities that emphasize the process of critical and analytical thinking to find and find answers to a problem in question that leads students to find answers to problems In general, the process of inquiry learning includes five steps namely formulating the problem, proposing a hypothesis, collecting data, testing hypotheses, and drawing conclusions [8, 9, 10].

Developing an e-module in this study using the application kvisoft flipbook maker [11, 12, 13, 14, 15]. Applications can make the learning process interesting because through this application can be incorporated motion animation, video, and audio to make a resource becomes more interesting and not monotonous because it only contains the writings [15, 16]. Chemistry is a part of Natural Sciences that is obtained and developed based on experiments to find answers to the questions of what, why, and how natural phenomena are especially related to the composition, structure, nature, transformation, dynamics, and energetics of substances [13]. In the eyes of students, chemistry subjects are difficult subjects because they are abstract and complex that requires reasoning and high-level thinking [17, 18] so that it causes students to learn difficulties and errors in understanding chemical material [19].

The chemical material studied in class XI SMA / MA is the reaction rate material. The reaction rate material is one of the materials in basic chemistry. The Material is composed of several sub-subjects such as the concept of reaction rate, factors that influence the reaction rate, rate equation, reaction order, and the collision theory. Reaction rate material is one of the basic materials in chemistry which consists of abstract concepts [20, 21]. Based on the results of interviews and observations at SMA Negeri 1 Seberida Indragiri Hulu Regency, students tend to be passive when learning chemistry takes place. In class XI MIPA B, amounting to 32 students, only 2 students asked questions during the chemistry learning process that lasted for 2 hours. Also, when the teacher gives questions to students, there is no response from students so the teacher finds it difficult to increase the active role of students during the learning process. Another fact found in Seberida Public High School 1 is the delivery of material contained in textbooks teachers still using conventional methods, namely lectures and student activities are listening, taking notes, and doing the exercises so that students have difficulty finding the concept of the reaction rate correctly.

At present the development of the reaction rate teaching materials has been carried out as in the form of modules [22], e-books [23], LKPD [24], but based on the analysis that has been done it is known that the teaching materials that are felt are still not able to answer 21st-century learning demands and 2013 curriculum. Therefore, researchers are interested in developing a reaction rate teaching material that is expected to answer the 21st-century learning demands and 2013 curriculum, namely the development of guided inquiry-based reaction rate e-modules as independent teaching materials.

2. Method

The development of guided inquiry-based reaction rate E-modules refers to the type of research and development (R & D) design with a Plomp model consisting of a preliminary research phase, a development or prototype phase, and an assessment phase [25] with the stages of developing this e-learning can be seen in figure 1.
Figure 1. Development Flow of guided inquiry-based reaction rate E-modules

The preliminary research phase was carried out to support the need for the development of guided inquiry-based e-modules on the reaction rate material. In this phase problem analysis is carried out with interview and observation techniques to identify learning problems in schools related to teaching materials used in chemistry learning reaction rate material, curriculum analysis is done by analyzing the contents, teaching materials, objectives, and guidelines for the implementation of learning activities (methods and models) that are recommended in the implementation of learning in the classroom, the analysis of teaching materials is done by analyzing the material and literature relevant to the material reaction rates and analysis of learners that aims to find out the characteristics of students who are then adjusted to the product to be developed. In the development phase or prototype, the guided inquiry-based e-module is designed as prototype 1 and the research instrument is designed. In the assessment phase, an assessment by a material expert validator of 3 people and a media expert validator of 3 people

to see how the e-module has been developed. Then a small scale test is performed to see the user's response to the practicality of the guided inquiry-based e-module.

The design and development of e-modules starting from May-August 2019 under supervised of experts of chemistry education S2 FKIP University of Riau. Then small-scale trials is conducting in SMA Negeri 1 Seberida, Indragiri Hulu. through interviews and sheets questionnaire validation and the questionnaire sheet user response. The instruments used as data collection were a teacher and student interview sheets, validation sheets of inquiry-based reaction rate e-modules guided by material and media experts, questionnaires for teacher and student responses. The validity of data analysis techniques, practicality e-module guided inquiry-based reaction rate using a scale Likert [26].

3. Result and Discussion

The results of the study of the literature note that it is expected to utilize IT in the process of learning chemistry and direct students to discover their concepts that are being studied. Also, it is known that chemistry is difficult for students to understand and very often students have difficulty in understanding concepts that ultimately lead to misconceptions about the concept of matter is the rate of reaction [20, 21, 27]. The results of the chemistry teacher interview at SMA 1 Seberida revealed that teaching materials used at school today for reaction rate material were still in printed form, namely textbooks delivered with conventional methods, namely lectures where students only listened, took notes, and did the exercises. So, with teaching material that such is less attractive learners because it contains just a description of the materials, formulas, and drawings so that learners are less interested in it. While the results of observation are known that students tend to be passive in the process of learning chemistry, especially the matter of reaction rates that out of 32 students in 1 class only 2 students ask questions when learning takes place.

Furthermore, an analysis of students is conducted. The results of the introduction of preliminary questionnaires and interviews can be concluded that the students' critical thinking ability on the reaction rate material is still low so students want a teaching material that can be used to learn the concepts of reaction rates independently and improve critical thinking skills. Furthermore, competency analysis and material analysis are performed. Competency analysis is carried out on the high school / MA chemistry course syllabus and material analysis by examining the concepts of reaction rates by the expected indicators and learning objectives.

The prototype development aim is to design a solution to the problems found in preliminary research. This phase is carried out pen design prototyping and instrument ratings. Designing the guided inquiry-based reaction rate e-module starts with collecting the tools and materials needed for prototype development. After all the tools and materials are collected, then conducted by making storyboards that in the corresponding right with the components of the E-module guided inquiry-based reaction rate that will be developed. While the design of assessment instruments is based on the e-module preparation guidelines issued by the directorate of high school development of the ministry of education and culture.

After the design of the guided inquiry-based reaction rate e-module is completed the assessment of the guided inquiry-based reaction rate e-module is based on the assessment instrument that has been designed. The instrument being designed is an assessment instrument for prototype validity (media experts and material experts) and an assessment instrument for practicality by users (teachers and students) on the guided inquiry-based reaction rate e-module that has been developed.

In the assessment phase validation of the guided inquiry-based reaction rate e-modules has been developed. Validation is done by 6 experts namely, 3 the subject matter experts and 3 the media experts. Validation of matter experts covering aspects of the feasibility of the content, presentation, language, and graphic while media expert validation assessment includes aspects of size e-module, the cover design, and content design. The results of the validation by the material expert on the prototype are presented in table 1.
Table 1. Results of Validation of Guided Inquiry-Based Reaction Rate E-Module Validation by Material Expert

| No. | Aspect                          | Validation | Criteria         | 
|-----|---------------------------------|------------|------------------|
| 1   | Content eligibility             | 78.11 %    | Valid enough     | 87.46 %          |
| 2   | Feasibility of presentation     | 77.49 %    | Valid            | 86.63 %          |
| 3   | Language Feasibility            | 83.30 %    | Valid            | 95.80 %          |
| 4   | Feasibility of graphics         | 68.75 %    | Valid            | 81.25 %          |

Based on the evaluation of three material expert validators conducted 2 times of validation, it was found that the guided inquiry-based reaction rate e-module that was developed for aspects of content, presentation, language, and graphic feasibility met the validity criteria. This is also by the research on "the development of an integrated inquiry-based integrated laboratory virtual e-module reaction rate for SMA / MA " by GR Gevi and Andromeda which shows that the e-module has a very high level of validity and practicality with a kappa moment value of 0.89 [6].

These results indicate that the material presented in the E-module of Guided inquiry-based reaction rate developed already complete and by the demands of core competencies, basic competencies that are expected [28]. Then language used in the e-module of guided inquiry-based reaction rate has also been by the rules of Indonesian is good and true, communicative, and easy to understand. E-module is said to be good if the phrase used is simple and easy to understand, so the information is conveyed clearly and the e-modules are user friendly [29].

Presentation of the E-module of guided inquiry-based reaction rate material by the indicators and learning objectives have been formulated. Presentation of the e-module of guided inquiry-based reaction rate equipped with images, videos, animations, and quizzes about the material reaction rate. It aims to make students more motivated and enthusiastic in learning and to improve students' critical thinking skills on the material rate of reaction. In the e-module guided inquiry-based reaction rate material is also equipped with the question of evaluation based thinking critical. Evaluation questions are a tool used to measure the success of the learning objectives that have been formulated [30].

Graphical of the e-module reaction rate of guided inquiry-based reaction rate material produced has written can be read clearly, have a layout or display cover in the e-module is interesting as well as images, animations, and videos are displayed observed. The next validation is validation by the media expert, the results of the validation by the material expert against the prototype presented in table 2.

Table 2. Results of the Validation of Guided Inquiry-Based Reaction Rate E-Modules by Media Experts

| No. | Aspect        | Validation | Criteria         | 
|-----|---------------|------------|------------------|
| 1   | E-module size | 79.15 %    | Valid            | 100%             |
| 2   | Cover design  | 81.25 %    | Valid            | 97.80 %          |
| 3   | Content design| 81.40 %    | Valid            | 94.60 %          |

Based on the evaluation of the validator of the media as much as 2 times the validation obtained that the e-module of the guided inquiry-based reaction rate developed has met the criteria of media validity. It is explained that with e-learning support learning because it utilizes computer technology that is currently developing. The acquisition of a fairly high percentage of aspects of the media for the evaluation of the e-module based on inquiry-based reaction rates shows that the e-module of the inquiry-based reaction rate developed does indeed support learning [32].

After the inquiry-based reaction rate E-module is passed through the validation stage by material experts and media experts and has been declared valid, then the guided inquiry-based reaction rate E- the module is tested through a small-scale trial to find out the practicality of the guided inquiry-based reaction rate e-module according to the user ie the teacher and students. Small scale trials were conducted in 3 schools namely, SMAN 1 Batang Cenaku, SMAN 1 Seberida, and SMAN 1 Rengat Barat. The results of teacher and student responses to the inquiry-based reaction rate e-module are given in tables 3 and 4.
Table 3. Results of Teacher Response of the Guided Inquiry-Based Reaction Rate E-Modules

| The practitioner | Average Percentage | Practical Criteria |
|------------------|--------------------|--------------------|
| I                | 77.50%             | Well               |
| II               | 87.50%             | Very good          |
| III              | 100%               | Very good          |
| Total            | 88.34%             | Very good          |

Table 4. Results of Students Response to the Guided Inquiry-Based Reaction Rate E-Modules

| School                        | Average Percentage | Practical Criteria |
|-------------------------------|--------------------|--------------------|
| SMAN 1 Batang Cenaku          | 92.10%             | Very good          |
| SMAN 1 Seberida               | 86.25%             | Very good          |
| SMAN 1 Rengat Barat           | 86.25%             | Very good          |
| Total                         | 88.20%             | Very good          |

Based on the results of trials on teachers and students through the teacher response questionnaire and student questionnaire responses to the e-module guided inquiry-based reaction rate, the results obtained that the e-module based on inquiry-based reaction rates have been very good in practicality with a percentage of 88.34 % and 88.20%. Test practicality a product implementing its test does not require a long time and does not require much effort and cost [32]. So, teaching material is said to be practical if the ease of use, the efficiency of learning time, and the benefits of using e-modules have been implemented by users and can be done repeatedly because a teaching material is said to be practical if the teaching material can be easily used in learning [22].

This guided inquiry-based e-module is said to be an independent teaching material because in the module it has been equipped with instructions for self-study so that students can carry out learning activities without the presence of the instructor directly and students can learn according to their abilities [33, 34]. In addition to being equipped with instructions, this e-module is also integrated with a guided inquiry learning model that has several stages of learning that can support students' learning independence. Then the guided inquiry model also functions to make it easier for students to understand the concept of the material and minimize the role of the teacher in the activity of students discovering the concept [35,36].

4. Conclusion
Guided inquiry-based reaction rate e-modules as an independent teaching material can be developed with the research and development design Plomp model. E-module has been stated valid by media experts and material experts. The responses of teachers and students to the guided inquiry-based reaction rate e-modules obtained an average value with very good criteria and very interesting. So, the guided inquiry-based reaction rate e-modules produced are considered appropriate to be used as independent teaching materials in learning chemistry of reaction rate material and can improve students' understanding of the material reaction rates and can answer the challenges of the 21st century learning.

5. References
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