Content Needs Analysis and Development of the E-Module Reaction Rate in School Chemistry

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Abstract. In today's era of technological development, it demands the availability of teaching materials that are the simplest to use and easily accessible so that users can easily study learning materials wherever and whenever. Therefore, this research was conducted to analyze the need for IT-based teaching materials and the development of teaching materials in the form of e-modules on the reaction rate material. This research was conducted concerning the Plomp development model which consists of three development phases, namely, the preliminary research phase, the development phase or prototype, and the assessment phase. The results of the needs analysis show that students and teachers need an IT-based teaching material that can be used to overcome the problems experienced in learning reaction rate material. And the results of the feasibility test for material and media experts showed that the e-module reaction rate developed was suitable for use in chemistry learning.

1. Introduction
Preparation innovative teaching materials, such as providing IT-digital-based modules and considering neuroscience learning theory as well as displaying mental images, simulations, animations, and chemical concept illustrations. Especially, this article provides a presentation on the speed of chemical reactions.

Teaching materials (prototype E-module products) of the chemical reaction are also expected to be a reference, a reference for teachers to explain the concept of chemical reaction rates to students - so that they are more attractive and easier to understand. For students, this E module can be used as remedial teaching material.

In line with the demands of the 21st century, where teachers / prospective teachers are expected to have qualified literacy competencies - including literacy of textbooks (reference material for PPG-PGTK-Mendikbud) which teachers always update knowledge by reading a lot, especially teaching materials that are following their respective fields of study.

Chemistry teachers who realize that chemistry is a branch of science in which there are abstract concepts [1]. This makes chemistry a complex science because chemistry learning does not only include the macroscopic discussion of the material, but also the submicroscopic and symbolic which are commonly known as three levels of chemical representation [2]. Also, chemistry learning cannot be separated from experimental activities to find answers to the questions of what, why, and how natural phenomena occur so that they can be generalized into a chemical concept [3]. Preparing innovative teaching materials (IT-Digital basis and Use of neuroscience learning theory -presenting-simulation- mental image illustration concept animation chemicals, chemical reactions, and reaction speed [4].
This teaching material (prototype E-module product) is also expected to be a reference for teachers in explaining the concept of chemical reaction rates to students - so that the learning material in the E module is more attractive and more easily understood.

Toward the 21st century, where the teacher and the candidate teachers are expected to have the competence good reading and good writing. Related to teacher reading habits is low, especially to read English textbooks. So the development of media resources learning materials is perhaps helping teachers and students updating knowledge and chemistry concepts as well.

Chemistry is a branch of science in which there are abstract concepts [5]. This makes chemistry a complex science because chemistry learning does not only include the macroscopic discussion of the matter, but also the submicroscopic and symbolic which are commonly known as three levels of chemical representation [6]. Besides, learning chemistry cannot be separated from experimental activities to find answers to the questions of what, why, and how natural phenomena occur so that they can be generalized into a chemical concept [7].

One of the chemistry learning materials is the rate of reaction material. Reaction rate material is material in basic chemistry that studies several sub-topics, namely, the concept of reaction rate, collision theory, factors that affect reaction rates, reaction rate equations, and reaction order [8]. This reaction rate material is the basic material in chemistry which consists of abstract concepts [9].

Abstract concepts are generally difficult for students to understand. The tendency that occurs when students learn abstract concepts only by memorizing existing theories without understanding them, which in turn leads to misconceptions [10]. Therefore, one of the efforts to overcome students' learning difficulties in understanding abstract concepts in the reaction rate material is to develop teaching materials.

Teaching materials are all forms of materials used by teachers/instructors in carrying out classroom learning [11]. One form of teaching material that students and teachers can use in learning is a module [12]. Modules are printed teaching materials that include organizing learning materials [9]. Besides, modules are also defined as teaching materials which include learning objectives, usage guides, material descriptions, essence, evaluation, and feedback as well as follow-ups that are systematically designed and functioned as a means of independent learning [13].

Along with the development of the 21st century which is characterized by technological developments [14]. Where the use of technology is indispensable in various fields including in education [15]. Therefore, an IT-based module was developed called the electronic module (E-module). E-module is an innovation from a print module that can be accessed via a computer that is connected to the software and has been integrated and supports accessing the e-module [16]. Advantages of E-module compared to modules print plain is E-module is interactive and allows the appearance of images, audio, video, and animation and animation. E-modules can also be equipped with tests or quizzes as a means of assessing teachers to students.

2. Method
This research is a type of development research with the design of the Plomp model which consists of three phases, namely the preliminary research phase, the development phase or prototype, and the assessment phase [17]. The research conducted is limited to the development phase or prototype because the research only looks at the feasibility of the e-module being developed

2.1. Preliminary Research Phase
The preliminary research phase was carried out to support the need to develop an e-module of reaction rate material. In this phase, carried out the analysis of the problem by engineering a questionnaire analysis of the needs of teachers and students to identify issues that relate to the materials used in chemistry learning material reaction rate as well as teaching materials expected by teachers and students, the analysis of the curriculum is done by analyzing the content, materials teaching, objectives and guidelines for implementing learning activities (methods and models) that are recommended in the implementation of learning in the classroom, the analysis of teaching materials is
carried out by analyzing the material and literature relevant to the material reaction rate and student analysis which aims to determine the characteristics of students which are then adjusted with the product to be developed.

2.2. Development Phase Or Prototype
At f as development or prototype carried the designation of the module as a prototype 1 and designing instruments of research. In phase assessment conducted assessment by the validator expert material as much as 3 people and validators expert media as much as 3 to see how the feasibility of e-modules has been developed.

3. Result and Discussion
This research produced a product in the form of an e-module of reaction rate material that can be used in the chemistry learning process. The stages of e-module development that have been carried out are as follows:

3.1. Preliminary Research Phase
In this phase, an assessment of the basic problems faced by students and teachers in learning chemistry has been carried out, especially the reaction rate material, so that e-module learning is needed. The results of the assessment of the problems experienced in learning chemistry in the reaction rate material are textbooks used by students and teachers, the level of understanding of students after studying the reaction rate material, the reaction rate material that is difficult for students to understand, and the teaching materials expected by students and teachers. (add data - descriptive information - from collecting questionnaires) and book review results ...

The results of the analysis of textbooks used by students and teachers are that in general students use textbooks that have been provided by the school, where students and teachers think that the available textbooks do not explain the reaction rate material, do not provide the latest information regarding the reaction rate material. According to the teacher, the use of textbooks like this causes students not to get a bad understanding, especially for calculation material because sometimes students find it difficult to understand how to solve problems simply. Where only 60% of students understand that learning uses school textbooks.

Sub material that is difficult to grasp the students in the learning material is the reaction rate of the collision theory, the calculation of the reaction rate, and the factors that affect the rate of reaction because the material is the participant students are required to understand the things that abstract. The efforts that have been made by the teacher to minimize student learning difficulties are by utilizing instructional media in the form of video and learning animation, teaching material slowly and repeatedly, and increasing problem-solving exercises, and providing examples in everyday life.

Based on the problems experienced by teachers and students in learning this reaction rate material, students and teachers expect a teaching material that can answer these problems, namely IT-based teaching materials that can be included in various videos, learning animations, and practicum simulations, which can add to students’ understanding of the reaction rate material.

The results of material analysis reaction rate on some books high school chemistry found that the presentation of the material reaction rate on books high school chemistry that is not following the competence-base that is expected on the syllabus curriculum in 2013 is KD 3.6 and 3.7, the description of material reaction rate more dominant in the form of words only a few sub-materials are added to the image as an amplifier explanation of the matter, explaining material on factors that affect the reaction rate is not too specific only explanation appetizer course, then not attached drawings which supports an explanation of how the particles when reacting and link material which can be used to add to the understanding only be provided on a sub material particular course.

The results of the analysis of students known that the high school students of class XI generally in the age of 15-16 years, which at this age is said to be a period of transition someone from the period of childhood to the age adults, or more commonly known by the term period of adolescence.
to the theory of learning P target level of thinking of children, age is at the stage of development of the operations of formal (intellectually) that the child has been able to think logically and critically, draw conclusions and interpret, and have skilled in the use of media and can use the operations of concrete for farming operations are more complex [18]. This is taken into consideration in compiling the concepts of the teaching materials developed. At the stage of development of the operations of formal participant students also have been able to think in a critical and conclude something with the information that is available.

3.2. Development Phase Or Prototype

The prototype development phase aims to design a solution to the problems found in the preliminary research phase. In this phase, the prototype design and the e-module feasibility instrument were designed. Designing the reaction rate e-module prototype begins by collecting the tools and materials needed for prototype development. After all the tools and materials are collected, a storyboard is then made according to the components of the reaction rate module that will be developed. Meanwhile, the design of the feasibility instrument is based on the e-module development guide issued by the directorate of high school guidance, the ministry of education and culture.

After doing designing e-module reaction rate, continued feasibility, and practicality of the module rate of the instrument has been designed. The instrument that was completed was an instrument to suit the prototype (media expert and material expert) on the reaction rate module that had been developed.

3.2.1. Material Expert Feasibility Test Results

The feasibility test of the e-module material was carried out by 3 material experts covering aspects of the feasibility of content, presentation, language, and graphics. The test results can be seen in Figure 1 below.

![Figure 1. Results of the Material Expert's VALIDATION](image)

Based on the test results of the three expert validators (ahi atari, instructional designer expertise, and linguistic aspects) the material carried out twice shows that there is an increase in the percentage of test results I and II. This shows that the e-reaction rate module developed is feasible in terms of the feasibility of content, presentation, language, and graphics. These results indicate that the material presented in the e-a module developed reaction rate is already clear, complete, and following the demands of core competencies, basic competencies expected [19]. Then the language used in this reaction rate e-module is also following the rules of Indonesian which are good and correct,
communicative, and easy to understand. E-module is said to be good if the word is used in simple and understandable, so that information is conveyed clearly and the e-modules are user friendly [20].

3.2.2. Result of Due Diligence of Media Experts
The feasibility test of the e-module media was carried out by 3 media experts covering aspects of e-module size, cover design, and content design. The test results can be seen in Figure 2 below.

![Figure 2. Due Diligence Results for Media Experts](image)

Based on the results of the three test results of the media expert validators twice, it can be seen that there is an increase in the percentage of the feasibility of test I and test II. This shows that the e-reaction rate module developed has met the eligibility criteria for the media. The acquisition of a high enough percentage in the media aspect shows that the e-reaction rate module developed does support learning [21].

In line with the results of the review of high school textbooks that are not well presented about what the concept of reaction speed is and when and under what conditions the reaction occurs. The concept of reaction occurs based on. Only a sufficient number of effective collisions produce a chemical reaction. This concept book is not / less clear to most students. To better explain the concept of the collision, it can be done through animation - on IT media programs such as KSoft bookmaker. So that the three-dimensional animation can generate a mental image that imparts abstract chemical concepts for students with auditory learning styles, spatial apart from the large impact surface area. This can be seen in Figure 3 below.

![Figure 3. The mental image that collision occurs](image)
An illustration is more detailed below in figure 4. It is describing 2 types of collisions. Figure 4.a is described as an effective collision. It means that two kinds of particles collide with each other with matching orientation and with the right position. Cl ion collides with the right position and orientation Cl from Cl bonded in CINO. On other hand at collision 4 b. It is called an ineffective collision. The ineffective collision is not becoming a reaction (no reaction happened). Because it is not occurring in the right position and right orientation.

![Effective and Ineffective Collisions](image)

**Figure 4.** A few types of collision

The book review of the Senior High School Chemistry textbook is also founded that most books do not display the concept of surface area square that describing an influencing area of the surface. Figure 5 below the Mathematica potential approved that the tinier of the particle, its surface area is bigger itself. So it is related to the smaller particles, the area is bigger. it is more chance to contact each other of the reaction of particles. Hence, it is faster than the reaction itself. The influence of surface area affects the speed of the reaction.

![Surface Area Example](image)

**Figure 5.** Result of Due Diligence of Media Experts

Based on the illustration figure 5 above, if we have a cube-shaped object with the same length, width, and height, which is 1 cm. Then the area of the cube is mathematically 6 cm2. If the cube is cut into 8 equal parts, namely the length, width, and height of 0.5 cm each, then the surface area of the cube is $6 \times 0.5 \times 0.5 \text{ cm}^2 = 1.5 \text{ cm}^2$. If there are 8 parts, the surface area of the cube will be $8 \times 1.5 \text{ cm} = 12 \text{ cm}^2$. So, reducing the size of the cube will increase the surface area.

4. Conclusion

It is necessary to look at the details of the availability of material that is in accordance with the indicators of teaching materials that are in accordance with the competencies that students must have after studying chemistry, especially the material on reaction speed and the factors that influence it. The weakness of two-dimensional book offerings and the unavailability of adequate explanations, such as initial knowledge of the speed of reaction material, also affects students' interest in learning chemistry. For example, not all books present the conditions for a reaction, so in the E-Module an animation is presented in the form of orientation and type of collision as a condition for the occurrence of a reaction. To strengthen aspects of students' content knowledge, it is shown in a slow-motion, which
shows that particle size affects the area of material contact with reagent, the smaller the surface area (represented by the smaller cube size), the larger the surface area, (the area of the cube is getting bigger, students can also ask to calculate through simple calculations) - so that in simple math calculations, students can understand that how the influence of surface area affects the area of contact between the material and the reagent - so that the reaction occurs faster, it is approved evident that affect of the size of particle size.

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