Development of the SEQ-alfa© multimedia in Chemistry learning

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Abstract. This research aims to develop the SEQ-alfa© multimedia, especially on the addition of language types and the addition of pressure and volume factors as the effect of shifting chemical equilibrium. SEQ-alfa is a multimedia simulation that can visualize the dynamic nature of a reversible chemical reaction in the equilibrium process, as well as the visualization of the particles in a reaction to reach equilibrium. SEQ-alfa© can also visualize the shift in chemical equilibrium when one factor (concentration or temperature) in the system is changed. The research method used is Design Based Research (DBR). The results of this study are in the form of designs that will be used in the development of SEQ-alfa© multimedia learning media.

1. Introduction
Chemistry is a science that is very important to learn [1]. In chemistry there are basic concepts. The basic concept is important to understand by students because it becomes the basis for learning other chemical concepts with a higher level of difficulty [2]. One of the basic concepts in chemistry is chemical equilibrium [3]. Chemical equilibrium material is studied in second grade of high school. Chemical equilibrium becomes the basic concept for studying further chemicals such as the calculation of pH and pOH in the buffer solution material [4]. Besides chemical equilibrium is also a basic concept in studying the material equilibrium in solution and acid base equilibrium. There are several submitters that are studied in the concept of chemical equilibrium, including dynamic equilibrium, equilibrium shifts, and equilibrium constants [5]. These three things are important to understand comprehensively in studying chemical equilibrium so that understanding is not only quantitatively, but also qualitatively.

The concept of chemical equilibrium is one of the concepts considered complex because it requires understanding macroscopic, submicroscopic, and symbolic level representations [6]. Macroscopic representations describe the empirical nature of substances obtained through direct observation using the senses of a phenomenon. Submicroscopic representations cannot be directly observed because they describe at the level of particles described as atoms, molecules and ions. Symbolic representation describes the number of entities involved in each change that occurs with the use of symbols, formulas, or chemical equations [7].

Chemical equilibrium contains defined concepts, mathematical calculations, and graphs [8]. Besides chemical equilibrium is also a concept based on the principle because it uses the Le Chatelier Principle in studying the submersion of chemical equilibrium shifts [9]. In chemical equilibrium shift submersion, it is discussed about chemical equilibrium shift reactions that occur due to the influence of concentration, temperature, volume, and pressure that will be difficult for students to understand if only expressed by reaction equations because they do not describe the process of dynamic equilibrium that actually occurs.
at the submicroscopic level [10]. The results of the practicum also can only provide a picture of macroscopic changes of the reacting substances which can only be seen in plain view. So that students can understand the concept of chemical equilibrium as a whole, it is necessary to innovate that can make students understand chemical representations consisting of macroscopic, submicroscopic, and symbolic representations as well as connecting the three levels of representation.

One of innovation that can be done to strengthen students' conceptions of chemical representation is to use instructional media with computer technology or android [11]. Computer or android technology can convey material using words (verbal), diagrams, pictures, and two or three dimensional models. By using this technology students can visualize concepts that are classified as abstract. Computer simulations can present complex, abstract and dynamic chemical concepts or known as CAD (complex, abstract, and dynamic) at the macroscopic, submicroscopic and symbolic level representations so as to enhance students' chemical representation abilities [12].

One of the multimedia simulations that can visualize macroscopic, submicroscopic and symbolic representations in the chemical equilibrium process is SEQ-alfa©. In this simulation provides calculations, graphs, and visual analogies of the concept of chemical equilibrium. SEQ-alfa© can describe the dynamic nature of chemical equilibrium through the visualization of a reversible reaction so that it can visualize the three levels of representation well. This multimedia can display the process of achieving chemical equilibrium and describe the process of shifting chemical equilibrium caused by changes in concentration and temperature factors. This reaction in multimedia is described through the molecular depiction of the reacting substances. Based on the results of previous studies, it is known that SEQ-alfa© can improve students' cognitive abilities [13].

From these results, the researcher intends to develop SEQ-alfa© learning media in the form of features contained in the multimedia to be more complete. Innovation becomes important to add value to a product. Among the developments that will be carried out include expanding the types of language used and adding the effect of pressure and volume on shifting chemical equilibrium.

2. Methods
The research method used was Design Based Research (DBR). Design based research is a new paradigm or methodology in educational research that is based on both theory and previous research with the aim of improving educational practice [14]. One of special feature of this research method is the development of products based on needs. The development of this product is also based on the results of previous studies with the aim of improving educational practices. The stages for developing SEQ-alfa© multimedia are based on the following design-based research stages [15]:

![Figure 1. Stages of design based research.](image)

The first stage is the stage of problem analysis through the results of the application of multimedia SEQ-alfa© which has been done by other researchers before. After knowing the existing problems, the researcher analyses the problem by studying the relevant theory about concept of chemical equilibrium. In the second stage, researchers began to develop multimedia design plans that will be developed. This development is associated with theories and concepts that are relevant and supportive in the development of SEQ-alfa©. In the third stage, the validator evaluates the SEQ-alfa© development results.
Furthermore, product trials are carried out in the field of development as well as data collection and analysis. If there are still deficiencies in the results of the trial, a product development revision is carried out. In the fourth stage, reflection is carried out.

3. Results and discussion

The results of this study are in the form of an overview for the development of SEQ-alfa© multimedia in the addition of Indonesian and the pressure and volume factors towards chemical equilibrium shifts.

3.1. Problem analysis

Based on the results of the analysis of the problem through the application of SEQ-alfa© that has been done by researchers previously known that there are concepts that are not yet available in SEQ-alfa©, namely the influence of pressure and volume factors in chemical equilibrium shifts. So it is necessary to add the influence of pressure and volume factors in chemical equilibrium shifts. In addition, SEQ-alfa© can only be used in English and Spanish. Researchers want to develop SEQ-alfa© by adding Indonesian to access the multimedia. Use of simulation or animation can improve student understanding at the macroscopic and molecular level because students are directly involved in collecting data to understand the concepts being learned [16]. SEQ-alfa© multimedia is considered very good to be applied to high school students, including in Indonesia, so their language difficulties are not an obstacle in implementing it.

3.2. Product design development

At this stage the researcher develops a solution based on the theory that has been studied previously. Product development begins with an analysis of basic competencies, learning objectives, materials, and types of content that will appear in multimedia. Furthermore, it is made in a flowchart and storyboard. Flowcharts describe the sequence of processes in detail and the relationship between one processes to another in multimedia. The appearance of the flowchart in the development of multimedia is shown in the figure 2.

![Flowchart of SEQ-alfa© multimedia](image_url)

**Figure 2.** Flowchart of SEQ-alfa© multimedia.
Storyboard contains a general description of the development made. The appearance of the storyboard in the development of multimedia is shown in the figure 3.

| Scene 3 | Visual | Explanation |
|---------|--------|-------------|
| ![Storyboard](image1.png) | CHEMICAL EQUILIBRIUM SIMULATION | This scene contains the main menu page. Background: white. Text: Black and white, except for substances that react (A: green; B: blue). Animation: reaction simulation of the process of achieving chemical equilibrium. Buttons: - Endothermic and Exothermic: to determine the state of the reaction - Simulate: to start the simulation of chemical equilibrium - Restart: to do a simulation with new reaction data |

Figure 3. Storyboard of SEQ-alfa© multimedia (scene 3).

Figure 3 shows the page when the chemical equilibrium simulation has not yet begun. User must enter the initial reaction data to start the simulation. The data are initial concentration, reaction state (endothermic/exothermic), temperature, pressure, and volume.

| Scene 4 | Visual | Explanation |
|---------|--------|-------------|
| ![Storyboard](image2.png) | CHEMICAL EQUILIBRIUM SIMULATION | This scene contains the main menu page when the simulation has been carried out. Background: white. Text: Black and white, except for substances that react (A: green; B: blue). Animation: reaction simulation, graphs, and table of reaction data of the process of achieving chemical equilibrium. Buttons: - Endothermic and Exothermic: to determine the state of the reaction - Simulate: to start the simulation of chemical equilibrium - Restart: to do a simulation with new reaction data - Change: to change the temperature of reaction |

Figure 4. Storyboard of SEQ-alfa© multimedia (scene 4).
Figure 4 shows the page when the chemical equilibrium simulation has been carried out. User can change concentration, temperature, pressure, and volume to simulate factors that affect shifts in chemical equilibrium. Then the reaction graphs and data tables will illustrate the process of achieving equilibrium again.

4. Conclusion
The development stages of SEQ-alfa© multimedia consist of the stage of problem analysis, product design development, testing and refinement of product development, and reflection of product development. Product development is carried out on the addition of language types (Indonesian) and the addition of pressure and volume factors as the effect of shifting chemical equilibrium.

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