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KIMI.AR Application for Easier and Interactive Chemistry Learning

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Abstract

Chemistry is a crucial subject since it covers the structure and makeup of the world around us. However, chemistry is frequently cited as a subject that students dislike. Most secondary school pupils believe that chemistry is difficult, uninteresting, and unimportant. Therefore, an improvement in learning technic is needed. An application called KIMI.AR was created in this research. KIMI.AR is a learning media in the form of a mobile-based augmented reality application regarding elements and the formation of chemical reactions that are expected to solve high school students' problems in the chemistry learning process. What makes the KIMI.AR application better than other chemistry learning applications is the focus on the displayed material according to the user's level and displaying descriptions in addition to 3D visualization that students can access through their respective Android devices. So, through the KIMI.AR application, learning chemistry becomes easier and more interesting.

Keywords: augmented relay; chemistry learning; mobile application

Abstrak

Kimia adalah mata pelajaran yang penting karena mencakup struktur dan susunan dunia di sekitar kita. Namun, kimia sering disebut-sebut sebagai mata pelajaran yang tidak disukai siswa. Kebanyakan siswa sekolah menengah percaya bahwa kimia itu sulit, tidak menarik, dan tidak penting. Oleh karena itu, diperlukan perbaikan dalam teknik pembelajaran. Sebuah aplikasi bernama KIMI.AR dibuat dalam penelitian ini. KIMI.AR merupakan media pembelajaran berupa aplikasi augmented reality berbasis mobile mengenai unsur dan pembentukan reaksi kimia yang diharapkan dapat memecahkan permasalahan siswa SMA dalam proses pembelajaran kimia. Yang membuat aplikasi KIMI.AR lebih baik dibandingkan aplikasi pembelajaran kimia lainnya adalah fokus pada materi yang ditampilkan sesuai level pengguna dan menampilkan deskripsi serta visualisasi 3D yang dapat diakses siswa melalui perangkat Android masing-masing. Jadi melalui aplikasi KIMI.AR pembelajaran kimia menjadi lebih mudah dan menarik.

Keywords*:* augmented relay; mobile application; pembelajaran kimia

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Introduction

Education is the most important thing in a country's development. The Industrial Revolution 4.0 era has a serious impact on the aspect of education (Lase, 2019). With all the technological updates, developments of education quality are required to be higher than before. This is related to aspect number four of the Sustainable Development Goals, which is quality education (Saini et al., 2023). The process of creating quality education is a challenge for educators. Therefore, to solve this problem, continuous innovation is needed in the learning process, both in formal and informal education. One of the things that can be done is the development of learning media that can be built in a more interesting and interactive way for students.

Numerous science lessons are taught in secondary school, per the science teaching curriculum. Chemistry was one of them. Chemistry is a crucial subject since it covers the structure and makeup of the world around us (Sausan et al., 2018). However, chemistry is frequently cited as a subject that students dislike (Hofstein et al., 2011). Most secondary school pupils believe that chemistry is difficult (Ali, 2012), uninteresting, and unimportant (Broman et al., 2011). Students find learning chemistry challenging for a variety of reasons. The lecture is arguably the oldest and most popular teaching style in schools and colleges. It is thought to be an efficient approach to convey material in a way that student learning is mediated by the teacher (Cardellini, 2012).

According to Irwansyah et al. (2018), animation is needed to describe or explain more clearly the molecular phenomena of an element or chemical compound. The molecular phenomenon here is the visualization of three-dimensional objects that describe the strength of bonds between atoms or bonds between molecules which will be called learning media (Lawrie et al., 2016). This is also supported by research conducted by Cai et al. (2014) which states that students more easily understand and easily remember the chemistry material they learn using AR.

Mazzuco et al. (2022) discusses the systematic literature review in research of using augmented reality (AR) in chemistry teaching and learning activities. It is known that molecular structure is the most topic in AR for chemistry lessons. Cai et al. (2014) developed AR application. The AR application they produce is a desktop app in java form. Based on their research, AR helps to improve the student score, especially for children who have low scores in chemistry lessons. Then, Irwansyah et al., (2018) developed an AR application in a mobile app based on the Vuforia marker scan. This application has the potential as a learning medium for chemical molecular geometry about 70.83% to 92.50%. Next, Nechypurenko et al. (2020) developed AR application in a mobile app based on the hand phone reveal marker scan. This AR was created to study physical chemistry or better known as a virtual laboratory. Besides that, Macariu et al. (2020) produced an AR application for desktop app based on text recognition. Based on their research, AR Chemistry helped students answer their curiosity and develop their logic to study chemistry in an interactive way.

As one way of participation in quality education development, an application called KIMI.AR was created in this research. KIMI.AR is a learning media in the form of a mobile-based augmented reality (AR) application regarding elements and the formation of chemical reactions that are expected to solve high school students' problems in the chemistry learning process. This learning media has the advantage of an interactive learning process. One of the advantages of AR is that it can show three-dimensional visualizations that students can access through their respective Android devices. The KIMI.AR application has the advantage of having elemental and compound features. Apart from that, the KIMI.AR application can store all elements or compounds that have been scanned, so that students can carry out independent learning anywhere after being told how to use their AR.

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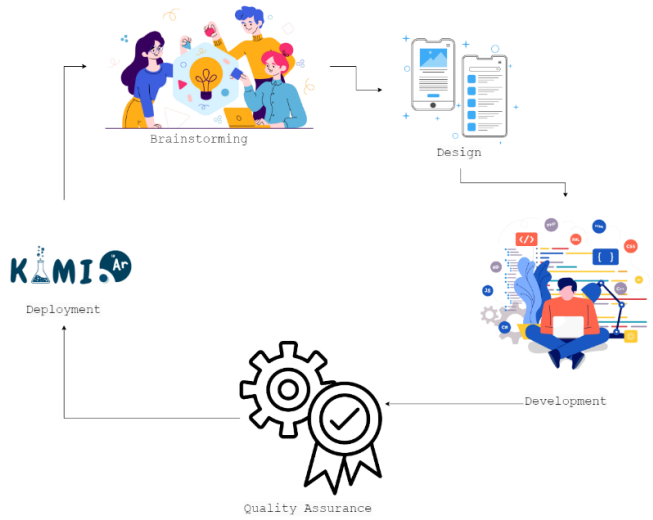
Method

The KIMI.AR application development method used is the Agile method. This method consists of five main stages as shown in Figure 1.

Figure 1
KIMI.AR Application Development Stages



The stages of this method form an infinite loop if there are still deficiencies in the application. The first stage is brainstorming, which uses data collection to design interaction process methods. At this stage, questions to be asked of the respondents were determined. The questionnaire will contain some questions such as name, difficulty in learning chemistry, difficulty to understand molecular phenomena such as molecular geometry, difficulty in understanding the reaction process between elements, difficulty in understanding the reaction process between compounds, and physical or chemical information on an element or compound that needed. The results show that 79.4% of the respondents require this application with the five things mentioned before.

The next stage is design, which makes the low fidelity and high-fidelity designs. After that, development and quality assurance stages were conducted to get feedback from prospective users. Then the final stage is deployment which is launching the application. At this stage an assessment called the System Usability Scale (SUS) which was developed by John Brooke was also conducted. In this assessment, KIMI.AR application obtained a score of 83 which belongs to range B and that means that the application can be useful for users.

Result and Discussion

A use case diagram is a diagram that describes the interaction relationship between the system and the actors. This use case diagram is part of the UML (Unified Modeling Language) which from the language we know functions as a modeling system. The use case diagram explains what actions actors can perform on the system. In this use case it is useful so that the sequential flow of activities in the system can be found, identify who can interact in the system and act as a bridge between developers and end-users.

The use case is important in developing applications to meet the user's needs. The use case diagram is shown in Figure 2. Based on Figure 2, there are two actors, namely new and old users. New users are required to create a profile. When a new user does that, the user can use all the features available in KIMI.AR such as opening elements, compounds, and scanning the card. Apart from that, all users can carry

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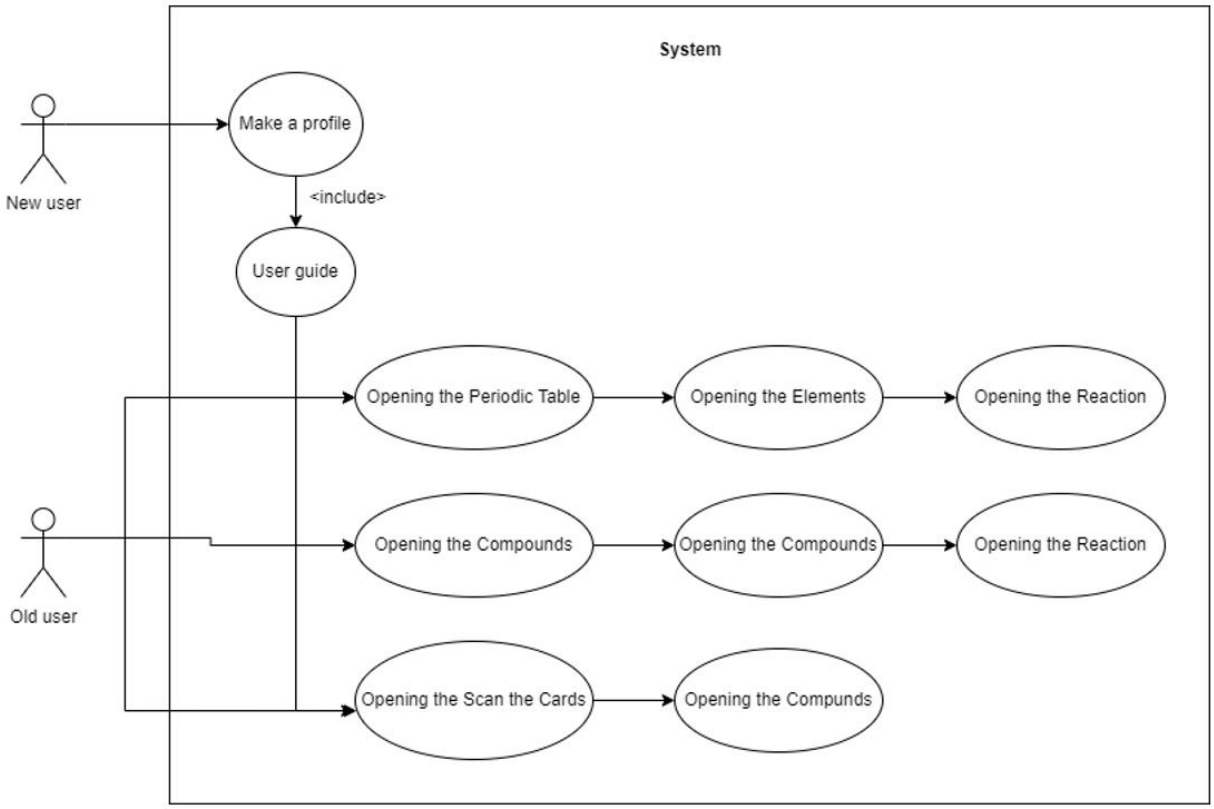
out reactions such as reactions between elements or reactions between compounds.

Figure 2
Use Case Diagram



There are several features, which are,

a) Sign-Up

To use the features contained in the KIMI.AR learning media application, users need to do the sign-up. Users can enter their name and class to activate the next button. The sign-up page is shown in Figure 3.

Figure 3
Sign-Up Page

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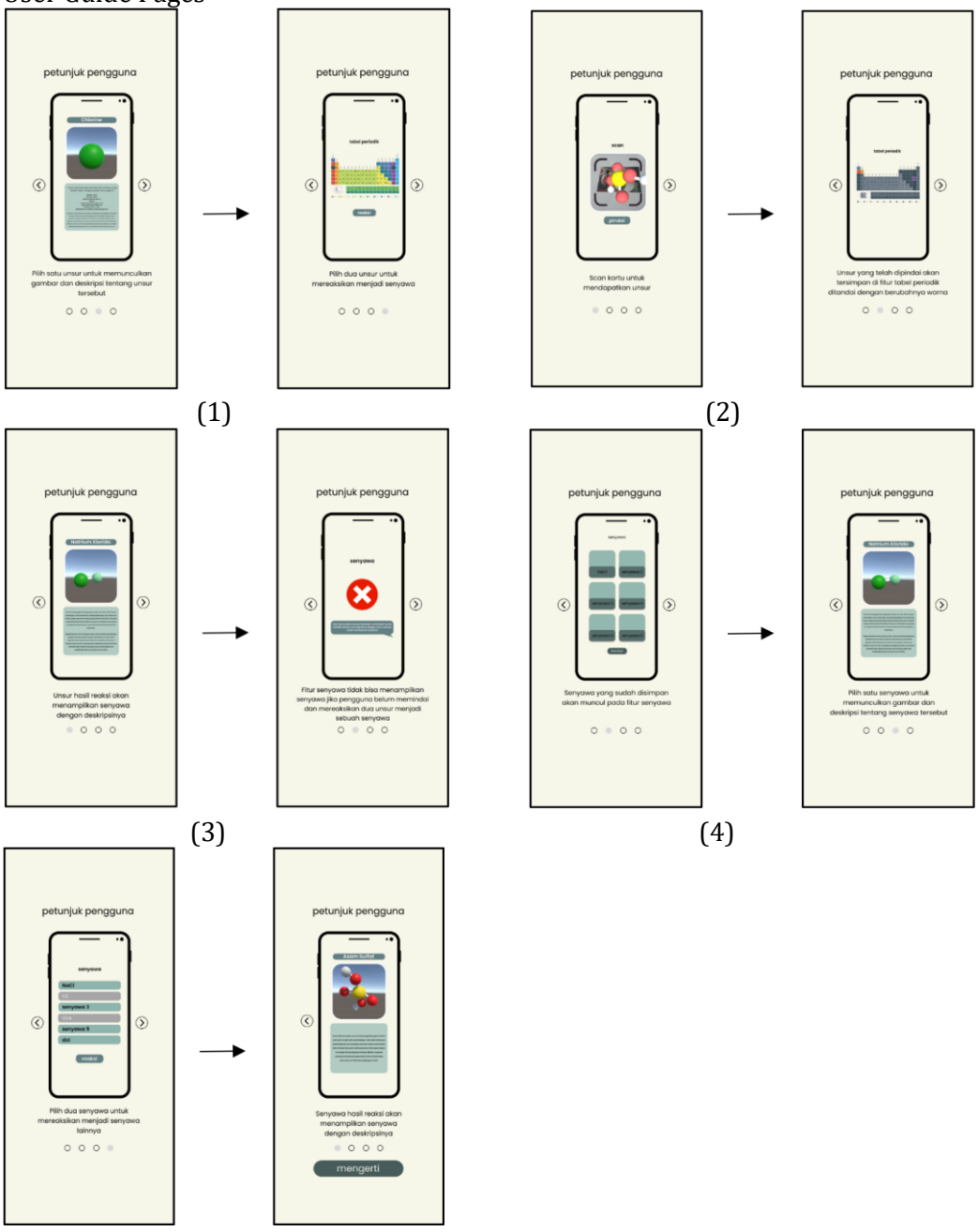
This means registering the user so that he can access all the features contained in the KIMI.AR application. This stage is only done once when the user starts the application for the first time. One of the advantages of the KIMI.AR application is presenting material according to the needs of the user class. Suggestions for materials that can be explored also adjust to the user's class so that the learning obtained remains focused on the user's level.

b) User Guide

The user manual is a guideline for users to find out how to run the KIMI.AR learning media application. The user guide consists of 10 pages which can be read by swiping right or left as shown in Figure 4.

Figure 4
User Guide Pages



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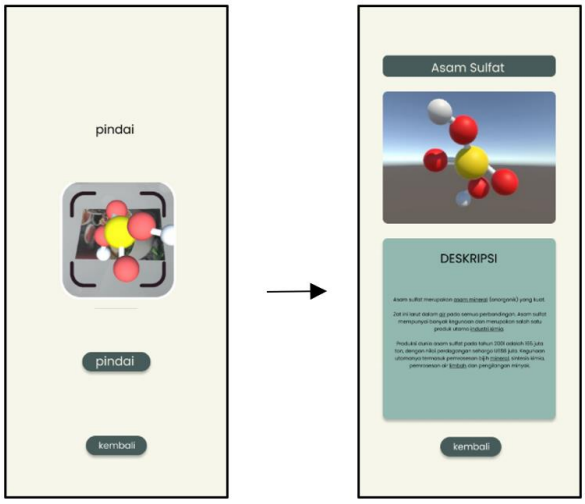
This feature provides tutorials for viewing 3D shapes of elements, transferring elements, and reacting elements and compounds. Based on the survey that was conducted, 73% of respondents felt that this feature was very useful for KIMI.AR application users. Users who are using the KIMI.AR application for the first time are shown the user guide feature. Basically, the user guide will only appear once in the first running application. However, the user manual can be retrieved by pressing the help button on the top right of the main menu page. Thus, users do not need to worry if they forget when using it.

c) Card Scanning

It is undeniable that the human memory memorizes the visualization of an object more easily than its name. And students tend to be curious about the forms of elements and compounds being studied. The KIMI.AR application answers this challenge through the scanning feature. Scanning can be done easily, even for handwriting. The visualization of this feature is shown in Figure 5.

Figure 5
Scanning Card Page



Card scanning will automatically activate the camera to detect the card and display a description of the item being scanned. This feature is the most important of all sections because it adds to the interest and curiosity of students to learn chemistry. Through 3D visualization, learning chemistry is no longer something abstract.

d) React Elements and Compounds

At the upper secondary level of chemistry learning, there is a subject about chemical reactions. The chemical reactions shown in the KIMI.AR application are reactions of elements and compounds. This feature becomes very interactive because it is equipped with a 3D visualization after the reaction. The element reaction page is shown in Figure 6a while the compound reaction page is shown in Figure 6b.

To react two elements into one compound, the user needs to collect the elements by first scanning the card. Then, the user can select any two elements present in the periodic table to activate the reaction button. After two elements have been successfully reacted to form a compound, a description of the compound will appear. Then, to react two compounds into one combined compound, the user needs to collect the compound by reacting to the elements first. Then, the user can select two compounds in the column provided to activate the reaction button. After two compounds have been successfully reacted to form a combined compound, a description of the compound will appear. The description displayed explains the name of the element or compound being reacted to, the group, and the nature of the new

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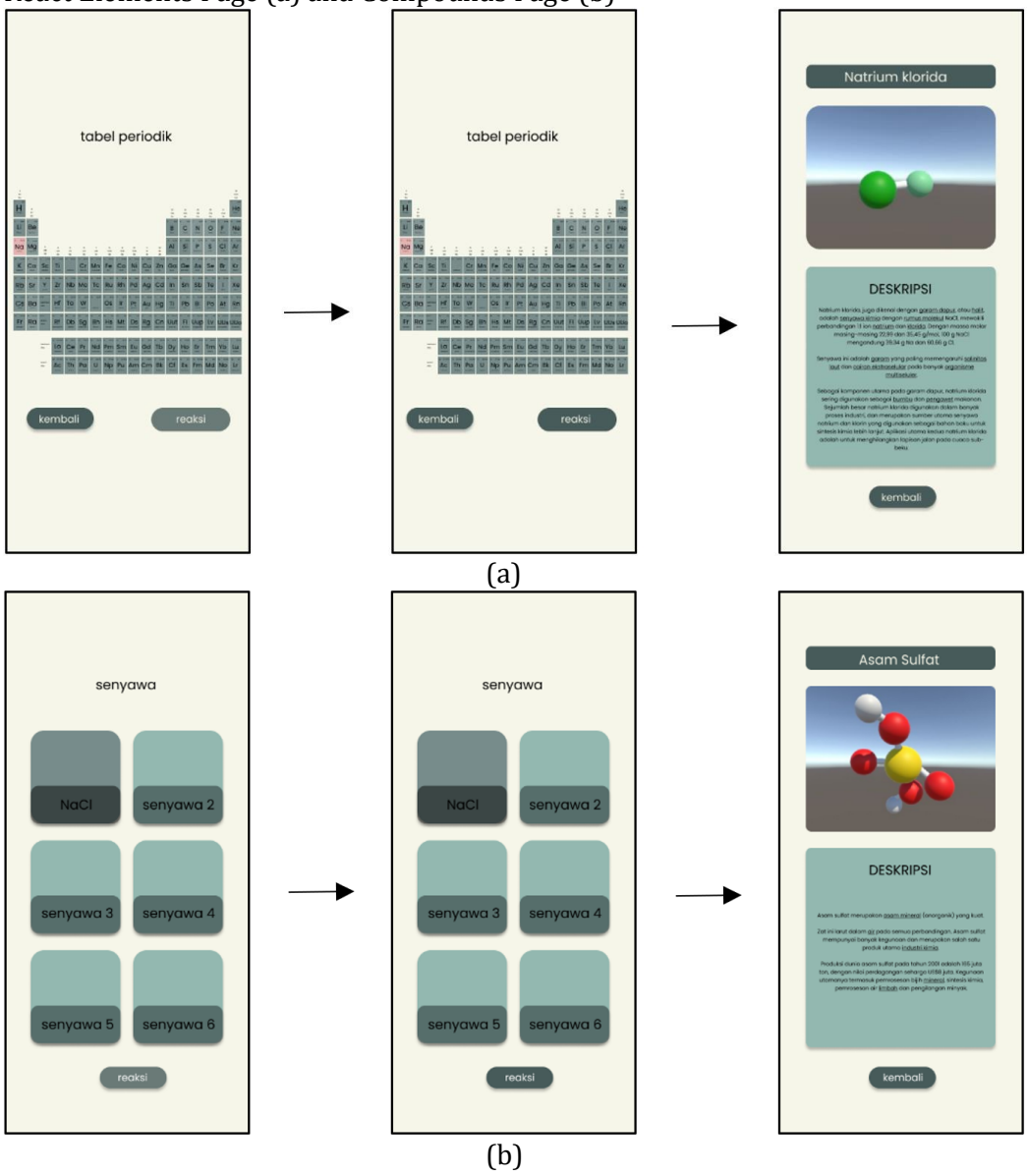
compound or molecule that is formed. Thus, more detailed information can be obtained by the user.

Figure 6
React Elements Page (a) and Compounds Page (b)



Conclusion

Based on a survey of 36 respondents, around 79.4% felt that the KIMI.AR application could facilitate the process of learning chemistry among high school students. The KIMI.AR application is equipped with various features such as sign-up, user guide, card scanning, and react elements or compounds. The KMI.AR application is an easy and interactive medium for learning chemistry. The 3D visualization that is displayed can raise the enthusiasm for learning and increase the curiosity of students. What makes the KIMI.AR application better than other chemistry learning applications is the focus on the displayed material according to the user's level and displaying descriptions in addition to 3D visualization.

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