Augmented Reality (AR) Technology on The Android Operating System in Chemistry Learning

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Augmented Reality (AR) Technology on The Android Operating System in Chemistry Learning

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Abstract. Augmented Reality (AR) is considered one of the most sophisticated technologies in virtual reality research and effective as a learning medium especially in chemistry. This study was aimed to describe the stages of AR manufacture technology-based learning media on the molecular geometry. The Research and Development had produced products in the form of AR technology-based learning media on the concept of molecular geometry. The stages of the research were carried out by design development and making the application on Android operating system and analyzing the results of a limited trial. This study shows that the manufacture of AR-based learning media on this android system has the potential to be applied to the learning of chemistry especially on molecular geometry subject.

1. Introduction

Chemistry learning on abstract concepts with concrete examples is not easily done both in the classroom and in the laboratory although the phenomenon in the concept can be observed visually, but for further explanation, animations are needed to describe the phenomena molecularly [1]. The molecular phenomenon in question is a model of visualizing a 3D object that describes a structure either physically or chemically as how strong the bonds between atoms, or describes the bonds between molecules and so forth and it has clear and precise information contained in a tool or often called learning media [2]. Learning media or tools used in addition to building visualization at the molecular level are also able to adapt to the material either in the form of words, images, or animations. The use of media as a tool in learning has become a very needed in the learning process either outside or in the classroom. And the media is often used by many people such as the use of Microsoft PowerPoint, and other conventional media, yet those technologies but the technology only puts learners as a passive element in the learning process [4]. Therefore, more advanced technology is needed to produce an interactive learning process. One of the most developed technology is Augmented Reality [5]. AR technology itself can be implemented widely in various learning media, either as an application in a smartphone, in a gift of a product, even print media such as books, magazines, or newspapers, making it easier for users in terms of tools and facilities because people can produce a very interesting learning medium with a low cost. [6]. One of the advantages of AR technology that can be used in learning that is able to provide 3D visualization and can be used in different android based smartphones used by students [7]. With these two basic features, AR can be used in learning chemistry that requires good visualization, so that the concept of chemistry is understood as intact as the concept of molecular geometry i.e. the shape of the molecular geometry composed of three-dimensional space of atoms in A molecule [8].

Research on learning media using augmented reality technology has previously been made on the concept of atomic structure oriented to the ability of submicroscopic representation and gives positive results in improving the ability to represent submicroscopic to learners, and to increase learning motivation, so that AR media is suitable to be used as a tool in learning [9]. Therefore, the researchers are trying to develop AR technology on the concept of molecular geometry, so that the existence of AR-based learning media on the concept of molecular geometry can help on real 3D objects visualizations [10].

2. Methods

The method used in this study was Design-Based Research i.e. a design that aims to produce a specific product, and test the effectiveness of the product. The object was the students of chemistry education UIN Sunan Gunung Djati Bandung in testing the use of AR-based learning media on the concept of molecular geometry.

The stages of making the learning media Augmented Reality on the concept of molecular geometry refers to the development of a tutorial-based CAI (Computer Assisted Instruction) model [11]. The general steps of AR-based learning media consist of two main parts;

2.1 Stage of AR-based learning media on android operating system

The first step to create AR media on the concept of molecular geometry is to create a molecule model and its marker using the Google Sketch Up, Corel Draw X5, and Unity 3D, and create an account on the Vuforia Developer site to register the results that have been made. AR-based learning media operates on a smartphone or computer-based android.

2.2 Limited Experiment Phase

he experimental phase was carried out to some chemistry students of UIN Sunan Gunung Djati Bandung who have been working on molecular geometry concept to fill the student worksheet (LKM) and a limited questionnaire.

3. Results and discussion

3.1 The stages of AR-based learning media on Android

The steps in creating AR media is adjusted to AR media capacity in performing 3 GAI functions (Graphic, Audio-visual and Interaction) The creation of AR media is capable of displaying sequential frames of graphics and each frame either a still image or motion picture capable of providing attractive optical illusions, audio-visual effects in incorporating 3D objects, animation and sound to the environment with virtual reality, and Enhance user interaction in the real world [13]. The first step is to install some applications needed on a computer like unity 3D as an application to build a variety of 3D object visualization that will be made augmented reality (molecular geometry), google sketch up as an application that sketches the making of geometry molecules, and Corel draw X5 as a marker image making application [14]. After the installation, run google sketch up to create 3D objects. To create a marker on an AR application, it is necessary to log on to an official site of the vuforia developer, it acts as a key license that the AR camera is ready for use, and then the marker has been registered with the vuforia developer [15]. After that, move the 3D object from google sketch up, and marker as the target image into the Unity 3D application. It is intended that 3D objects on markers can be displayed. The final step is to build apk extensions (android apps), this step requires Android Studio application to set the desired android version, so AR media can be used on android smartphone.

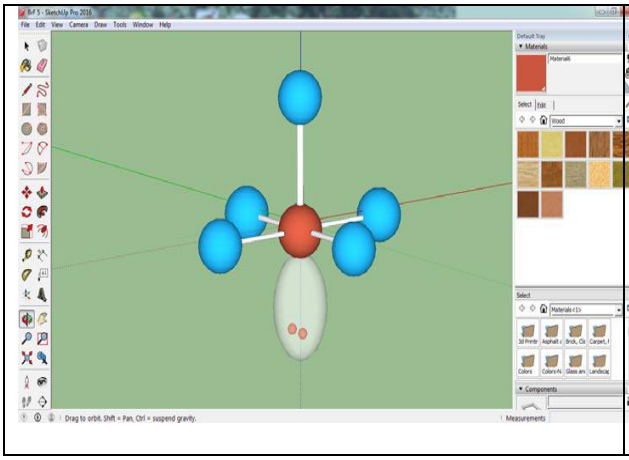

Figure 1. Creating Geometry Molecule with Sketch up

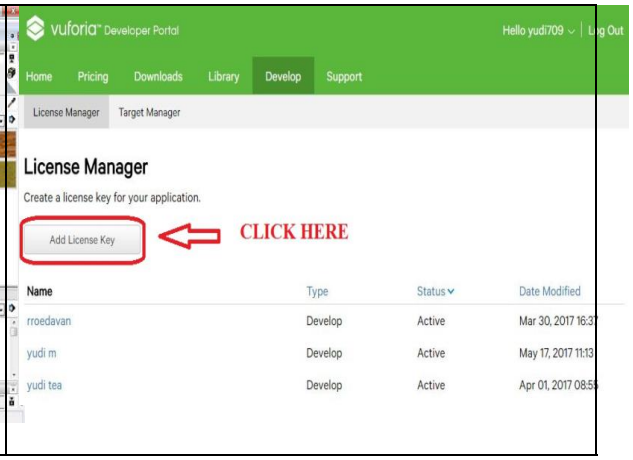

Figure 2. License Key Registration

Figure 1 shows the process of creating BrF_5 Molecule Geometry using Google Sketch up as a 3D object that will appear in marker. The key licensing process that serves to register the Unity (AR) project to be made is shown in Figure 2.

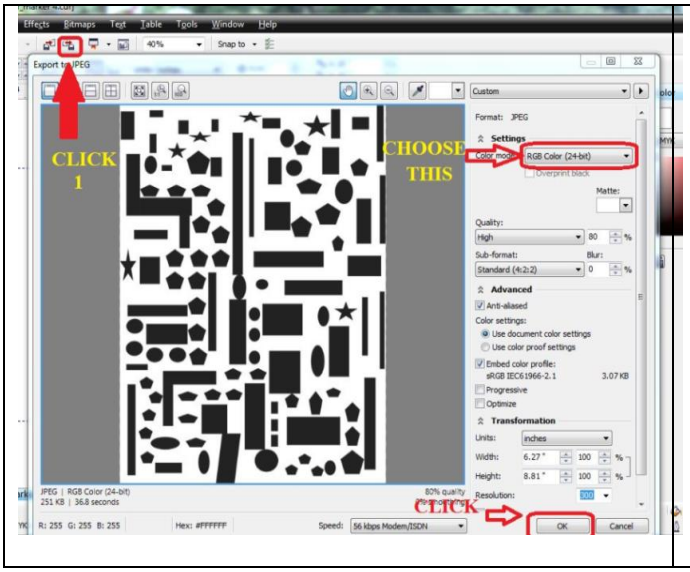

Figure 3. Creating Marker on *Corel draw X5*

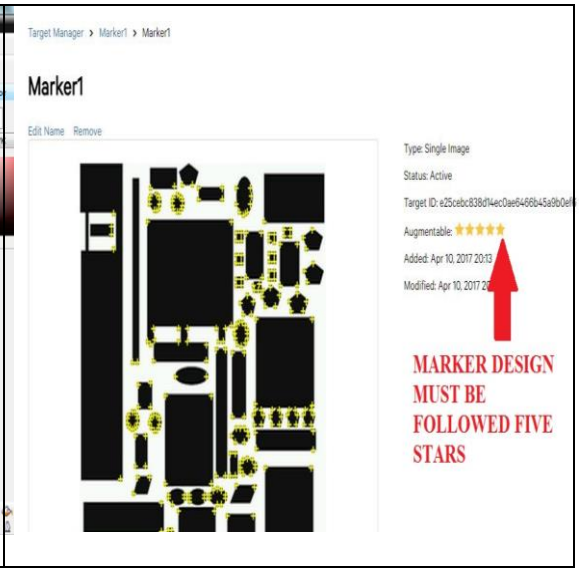

Figure 4. Marker has been registered in vuforia

Figure 3 shows a marker-making process using the Corel Draw X5 application, the marker was made with unique shapes to be easily detected by Developer Vuforia as in Figure 4, as well as 3D objects in the marker can appear on android smartphones [16].

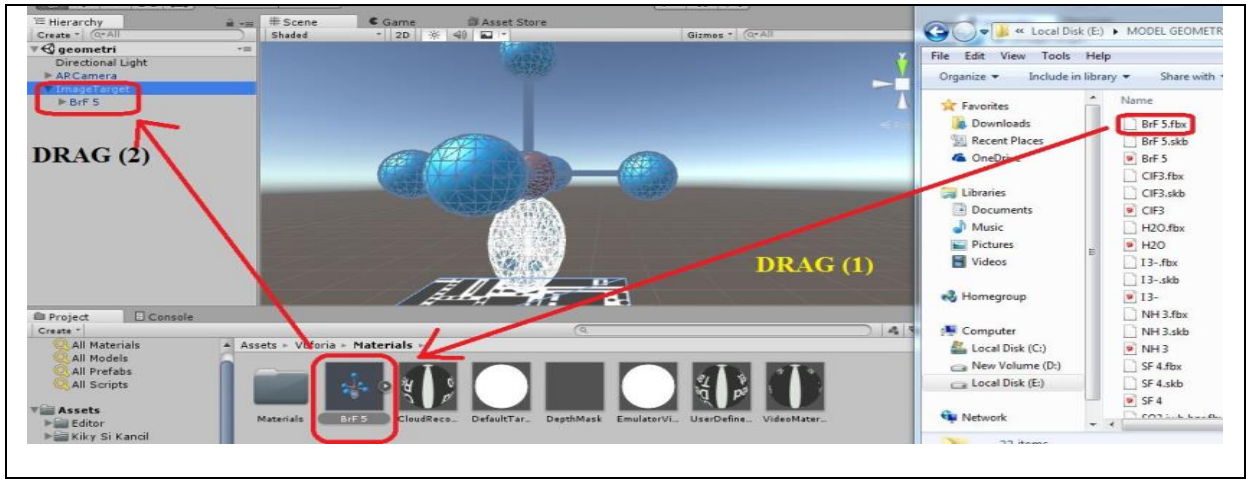

Figure 5. Combining 3D objects into Unity 3D application

Figure 5 shows the process of combining 3D objects from Google Sketch Up into the Unity 3D application, the thing to note is that the extensions in the Google Sketch Up app need to be changed into fbx, because the files that can be detected by the Unity 3D application are only two: fbx and obj, after changing the extension the object can be directly entered into the project Unity 3D and directly dragged into the game object. In Figure 6 shows the Build process or building a Unity 3D (AR) app into apk that can run on android systems, it can simply be done by selecting the files on the toolbar, then click build & amp; Setting will display the build settings table, then enter the name of the project on the add open scene (geometry), then click the settings player will appear on the right side of the screen in the form project settings, change the company name and project name, when finished then click build.

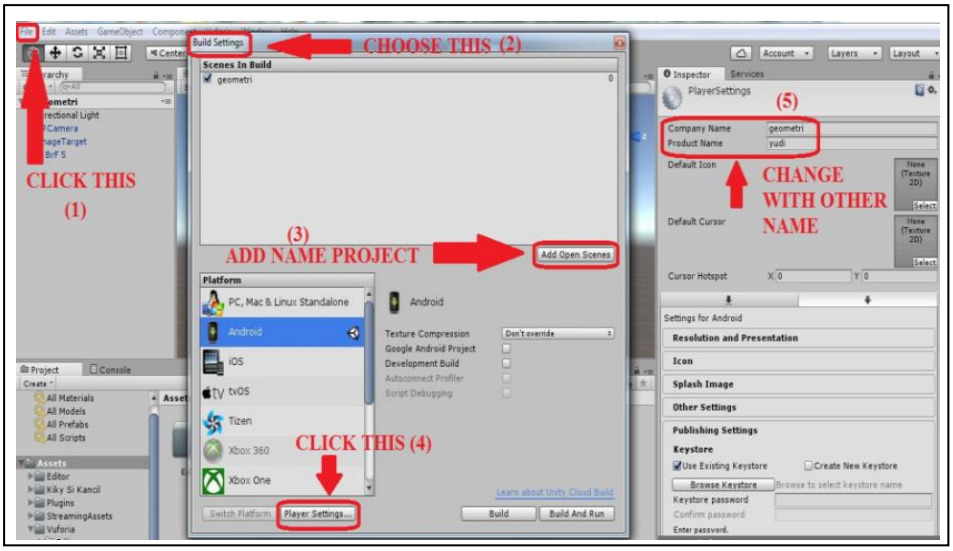

Figure 6. AR Build Media in Android

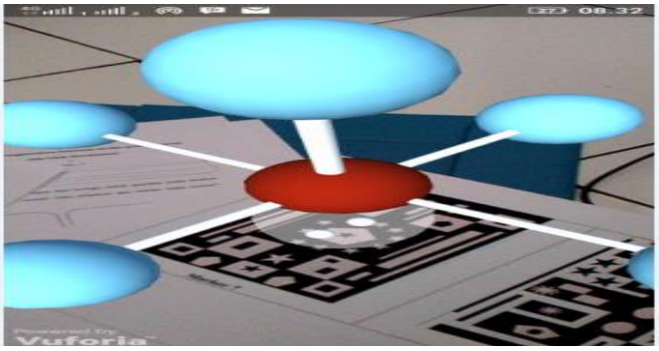

Figure 7. AR Learning Media on Android

Figure 7 shows the final process that displays 3D objects of molecular geometry on the smartphone android as a representation of the BrF_5 octahedral [17] The creation of AR-based learning media on this android smartphone can be combined with the use of student worksheets, as well as the achievement of learning objectives on molecular geometry materials. The display of AR-based learning media is: 1) the display of learning objectives to be achieved, 2) the display of compiler profiles, 3) AR media content display and 4) the exit button of the AR application.

3.2 Limited Test Results

The purpose of the test is to find out the students' assessment and responses to AR-based learning media that have been developed on the concept of molecular geometry, the test was conducted with 10 respondents selected randomly (the students of Chemistry Education Program UIN Sunan Gunung Djati Bandung). The following steps are taken as the experiments; first, the student was given the application to install it on their smartphone each they were given the student worksheet (LKM) and guidelines for using the media, after students completed the worksheet assisted by the use of AR media, the students were given a questionnaire to assess the instructional Media. The result of the test was presented in Table 1.

Table 1. Questionnaires Result based on Indicators

Indicators	Scores	Criterion	Percentage (%)
Learning Objective Relevance	107	120	89.16
Product Efficiency based on Time	57	80	71.25
Effectivity in Overcoming Media Limitations	91	120	75.83
Media Implementation Flexibility	64	80	80.00
Media Interface	90	120	75.00
Increasing Students' Learning Motivation	87	120	72.50
Learning Support capacity	85	120	70.83
Similar Media Development Prospect	37	40	92.50

Table 1 indicates that each indicator has different scores based on the assessment of respondents on each indicator by referring to the maximum criteria of each indicator. A value of 92.50% indicates that the development of AR-based media on the indicator has a very reasonable qualification, while some indicators have a range of 70.83-75.83% of which are eligible enough, and two indicators have a range of 80.00-89.16% with qualified eligibility. So as a whole that the manufacture of AR-based learning media on the concept of molecular geometry can be used as a learning source [18].

4. Conclusion

Through design-based research, a product in the form of AR-based learning media on android system has been successfully developed. The results of the test of AR-based learning media on the concept of overall molecular geometry have qualified sufficient enough to be very feasible to be used as a source of learning with percentage 70.83-92.50%. This result implies that AR-based learning media on android system has the potential to be applied to the learning of chemistry, especially on molecular geometry material.

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