The making augmented reality technology-based learning media in molecular hybridization concept

E N Asyiah, F S Irwansyah* and I Farida

Department of Chemical Education, UIN Sunan Gunung Djati Bandung, Jl. A.H. Nasution No. 105, Bandung 40614, Indonesia

Abstract. This study aims to describe the appearance of AR technology-based learning media on the concept of molecular hybridization. Design based research has produced products in the form of AR technology-based learning media on the concept of molecular hybridization. Research shows completing media creation, design development and application creation and analyzing the results of limited trials. This study shows the appearance of learning media AR has several characteristics namely attractive colors and appearance, and interactive and the making of AR technology-based learning media has the potential to be applied to chemical learning in accordance with the concept of molecular hybridization.

1. Introduction

Chemical phenomena depend on understanding invisible particles [1]. So that there are concepts in chemistry that are abstract and complex and difficult to understand [2]. Chemical phenomena need to be translated into multiple representations [3]. Multiple representations are macroscopic, symbolic and submicroscopic representations [4]. Generally learning emphasizes at the macroscopic level [5]. Though submicroscopic visualization is very important so students understand the concept of chemistry as a whole [6]. One concept that requires submicroscopic visualization is a hybridization process that produces hybrid orbitals that are difficult for students to imagine [7]. This resulted in a misunderstanding in interpreting the form of hybrid orbitals [8]. For this reason, it requires a submicroscopic representation in three dimensions. Submicroscopic visualization can use a tool called learning media [9]. Along with the development of science and technology, computer technology is now widely used in various fields, one of which is the field of education developed in learning [10]. More and more technology is being developed, namely technology using smartphones. The use of smartphones in learning activities can affect students' academic performance [11]. Students show a positive attitude when learning to use a smartphone and this makes it easier for students [12]. One technology that uses smartphones is augmented reality technology [13]. AR can be operated simply in a smartphone [14]. AR is a technology that can describe submicroscopically with 3D display [2]. AR can also be used for difficult teaching and abstract concepts that will make a breakthrough in education [15]. Therefore, the researcher intends to conduct research on making learning media that combines AR and animation with an attractive appearance.
2. Method
Method used in this research is Design Based Research (DBR) modified. This method is method based on technology that supports the learning process with two stages, namely the analysis stage and the design development stage [16].

2.1. Analysis stage
To obtain the accuracy of functions, software is an media support AR selected. The software used is blender, Corel draw and Unity 3D.

2.2. Design development stage
Phase at this stage, the media feasibility test was carried out AR to the chemistry education students of Sunan Gunung Djati UIN Bandung.

3. Results and discussion

3.1. The stages of media display analysis AR
On the initial menu page there is a media identity, namely the formation of covalent bonds based on the valence bonding theory. It aims to provide information to users about media identity AR.

![Figure 1. Display AR initial media menu on android smartphone.](image1)

![Figure 2. Instructions for use of AR media.](image2)

In Figure 1 the initial menu page contains a button to go to the user manual, basic competencies and goals, menu, compiler profile, questions, exit and start menu. Each display of media AR is interconnected by using buttons, this is so that the user can access the desired page. Figure 2 shows the display of the instructions menu that contains the steps of the media operation AR that will facilitate the user during the operation of the media AR.
Compiler next to the basic competencies and goals button, this button will connect the basic competencies menu and destination features (Figure 3) that display basic competency information along with learning objectives. It aims to provide information about what students must achieve in learning to form covalent bonds based on valence bond theory. The next appearance of the media is the viewer profile menu display (Figure 4) which displays the associated identity in the design of learning media AR. Then the main menu display (start) contains a menu related to the content of the valence and hybridization bond theory (Figure 5). The button starts directing the user to the orbital and hybridization buttons.
3D object will appear if camera AR detects marker. Markers made in square shape with black and white images (Figure 6). Then for the hybridization button the user will point the appearance of the various forms of hybridization (Figure 7). The hybridization sub-concept will direct the user to the animation display of the hybridization process. An example of an animated display of sp hybridization menu is presented in Figure 8. There is a button that pause, play, and animation progress bar aims to facilitate the user in analyzing the hybridization process displayed in the animation. In the animation display there is an orbital button that will direct the user towards the camera view AR and will display 3D objects (Figure 9).
In the media display AR next there is a menu of questions that contain questions about evaluation. Evaluation questions given aim to measure students' abilities to the extent of understanding learning through learning media AR that have been made [17]. The appearance of learning media AR has several characteristics namely attractive colors and appearance, and interactive. In line with Blijlevens et al., which states that attractive color design will give aesthetic pleasure to the user [18]. In interactive characteristics, the display is equipped with various buttons making it easier for students to use the application [19]. In the attractive display characteristics of the media, in line with Nazmi who stated that the appearance of attractive media will be able to stimulate thoughts, feelings, attention and interest in information, so that students will be encouraged to learn more [20].

3.2. Design development stage

Based on the results of feasibility on several indicators, it shows that the media AR can visualize the concept of valence bond theory which is abstract, it is expected that the same media with different concepts can also be visualized. From the indicators of relevance to material, product efficiency, media flexibility, and visual communication an average value of 88.59% was obtained, it can be concluded that this media is worthy of being used as a learning medium.

4. Conclusion

Appearance of learning media has interactive characteristics, facilitating the stages of covalent bond formation process by combining animation visualization and augmented reality, so that users can build an understanding of the hybridization process. The results of the feasibility test show that AR learning media on the concept of molecular hybridization is worthy of being used as a learning media.

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