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Design of Student Worksheets Based on Augmented Reality

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ABSTRACT

Design innovations on student worksheets need to be developed so that students are motivated to following the learning process. Many students difficult to understand an abstract concept of biology because they can not see directly. We can using Augmented Reality technology in the design of Student Worksheets as one of that innovation. Therefore a descriptive study was conducted to design a Student Worksheet based on Augmented Reality. The design process was carried out in two stages, namely analysis and design. The analysis phase was done by observing using questionnaires and the design stage was done by utilizing various computer software. The result of research is the design of Student Worksheets that is integrated with Augmented Reality, so the student can see the abstract object of biology by 3D AR directly with that technology. This result were expected to be developed and carried out further testing.

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1. Introduction

Learning innovation is development or a new discovery that is carried out on aspects of learning. One of the innovations that can be develop is in the form of Student Worksheets. The Student Worksheet is a printed teaching material containing a sheet equipped with instructions, steps to complete the task that refers to the basic competencies to be achieved (Prastowo, 2013). The purpose of the student worksheets is to help students find concepts, independent learning, and as learning guides (Depdiknas, 2008). The use of student worksheets in the learning process sometimes still does not achieve maximum results. This can be related to the design of the student worksheets used.

Constraints found in the Schools indicate that the learning process only uses student worksheets that is already available from MGMP, without any design or

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renewable innovation. There is a paradigm among educators / teachers that making teaching materials is spent many time, and exhausting as report by Nurina et al (2012). So that this is one of the reasons that there are many teachers did not want to develop student worksheets in the school. Students tend to be less motivated by the learning process that has taken place, this is thought to be caused by a lack of variation in the media and teaching materials used in schools. The report by Novitasari and Fajar (2017) 48.15% of students need something that can make the learning environment of biology more attractive especially for biological concepts that are felt by students.

The design of innovative teaching materials or learning media can be one of the efforts to attract the attention of students. Learning is a process that is closely related to the communication process of transferring knowledge from the teacher to students, which can be done through the intermediary of teaching materials or learning media. Interesting teaching materials are expected to overcome this problem. The design of teaching materials uses flexible principles. The principle is flexible means that it can accept new things in the subject matter that have not been included in the teaching material when implementing it by the teacher (Mbulu, 2004).

The use of technology in designing teaching materials can be applied in the learning process to help students learn biological concepts. One of them is Augmented Reality (AR) technology. Augmented reality (AR) is a technology that can combine a 3D object into a real environment using webcam media, both through a camera on a laptop or on a mobilephone as report by Bitter & Corral (2014), Wahyu et al (2007) dan Novitasari & Fajar (2017). The integration of AR can be innovated and developed through learning media or teaching materials, one of which is the development of Student Worksheets which include supporting learning media in the form of images that can display 3D animation (in the form of AR) that help students in the learning process. In addition, it will be even more interesting if it is used to study biological objects that are abstract in nature. Beside that, Augmented Reality can motivated students to following lesson nicely, as report by Dedy (2016), Mauludin et al (2017), Khan et al (2019), and Haryanto et al (2017) and that research support by Gusmida & Islami (2017) that had been study about augmented reality media and get a good quality outcome. Based on some research, so the design of student worksheet that integrated with Augmented Reality will be developed in order to make students interesting with the lesson and can be seen 3D object of biology directly from technology of Augmented Reality.

2. Methodology

The research conducted was descriptive research. The design of the Student Worksheet consisted of two stages. The first stage was an analysis phase which was carried out using observation questionnaires to several schools and interviews with teachers. Then the second stage was the design stage of the Student Worksheet. The design of Student Worksheets was done by utilizing several computer software such as photoshop, Ms.office, blender, vuforia, unity. The advantages of using that

software was an open source and free software. So, it will help and useful (Nasir et al, 2018). The stage of design 3D object can be seen in the Figure 1.

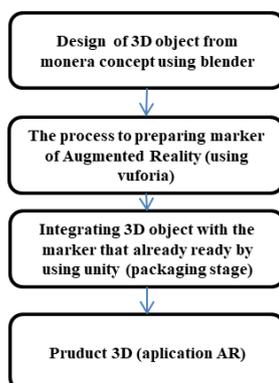


Figure 1. The stage of design 3D object

3. Results and Discussion

Analysis of Learning Materials

The Student Worksheet design phase begins by conducting curriculum analysis first, it is known that the curriculum used in the school that is the 2013 curriculum. Before the design was done, the material required an innovation in designing teaching materials in the form of Augmented-based Student Worksheets Reality. The results of observations carried out to show the percentage of material that was considered difficult by students. The analysis of biology learning material that is difficult for students can be seen in Figure 2.

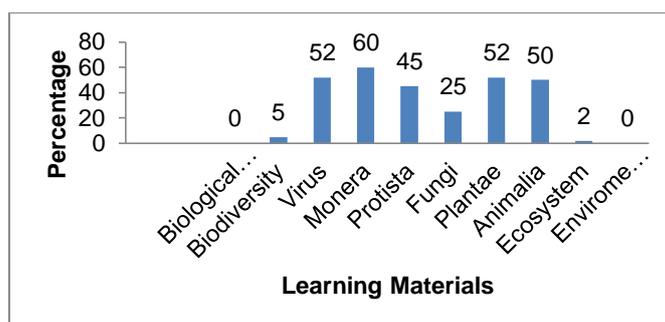


Figure 2. Analysis of Learning Materials

Figure 2 shows that 60% of students think that monera material is the most difficult material to understand. This can be caused of the material is abstract and cannot be observed directly. Some concepts in biology learning are classified as difficult to understand by participants, one of them being abstract concepts, such as the concept of monera (Archaeobacteria and eubacteria) as report Haryanto et al (2017). Some of students think that monera is a abstract concept, and the result shows that the average mastery of concepts is only 25.8%. Based on the results of the analysis, the design of Augmented Reality-based Student Worksheets for

monera material was carried out. The design of the student worksheets consists of 3 meetings. Translation of Basic Competencies and Indicators 3.4. can be seen in Table 1.

Table 1. Basic competencies developed.

Basic Competence (KD)	Learning Indicators
3.4. Apply the principle of classification to classify archaeobacteria and eubacteria based on their characteristics and forms through careful and systematic observation.	3.4.1 Analyzing bacterial characteristics
	3.4.2 Describes the structure of the bacterial body
	3.4.3 Analyzing forms of bacteria
	3.4.4 Analyzing the classification of bacteria
	3.4.5 Analyzing various ways of reproducing bacteria
	3.4.6 Describe the characteristics of cyanobacteria
	3.4.7 Analyze various ways of life of bacteria
	3.4.8 Analyzing the positive and negative roles of bacteria
	3.4.9 Determine attitudes or lifestyle prevention of harmful bacteria in life.

Designing Student Worksheets Based on Augmented Reality

Augmented reality is a combination of real and virtual objects in the real environment, the integration of virtual objects can be displayed in 3D. The incorporation of real and virtual objects in 3D by using certain program equipment and having reliable integrity requires an effective observation. Augmented reality (AR) is one of the latest technologies that offers a new way to educate. Due to the increasing popularity of mobile devices globally, the widespread use of AR on mobile devices such as smartphones and tablets has become a growing phenomenon (Danacorn et al., 2013).

Augmented reality has a fairly simple way of working based on image detection and commonly called a marker. For example, a camera that has been calibrated can detect a marker that has been designed, then after detecting the marker, the camera will do the matching with the database that was created previously. If the results match, then the information from the marker will be used to display 3D objects that have been designed in front of the user's screen, but if the marker does not match the database then information from the marker will not be processed (Ammatia, 2012).

The design of Student Worksheets is carried out by following the format of Depdiknas (2008) and using the Discovery Learning learning syntax. The syntax consists of Stimulation, Problem Statement, Data Collecting, Data Processing, Verification and Generalization. The Design of Student Worksheets used in the previous school and which will be designed can be seen in Figure 3.

1. Judul,
 2. Kompetensi dasar
 3. Tujuan
 4. Kegiatan (menjawab pertanyaan)

(a)
1. Cover
 2. Petunjuk penggunaan LKPD
 3. Peta Konsep
 4. Judul per LKPD
 5. Identitas
 6. Kompetensi dasar, Tujuan dan Indikator
 7. Informasi pendukung (Dasar Teori/wacana)
 8. Alat dan bahan
 9. Langkah pembelajaran
 10. Stimulation
 11. Problem Statement
 12. Data Collecting (Pengamatan AR)
 13. Data Processing and Verification (Diskusi dan pembahasan soal)
 14. Kesimpulan
 15. Penilaian

(b)

Figure 3. Format of the student worksheets used in the school (a), Format of the designed student worksheets (b)

Designing Cover of Student Worksheets Based on Augmented Reality using Photoshop software and for the design of the contents of the Student Worksheet using Ms. Office word and Power Point. While the 3D animation integrated in the Student Worksheet is designed using several computer software namely Blender, Vuforia, and Unity. 3D animation is designed with blender software, then to display 3D animations on the Student Worksheet, then the image is determined to be integrated with the 3D animation by using vuforia. Finally, the packaging of images containing a 3D animation database is carried out in an application for Android. The application can be used if it has been installed on Android. So to use this AR-based Student Worksheet, it is necessary to install the designed application. The design of the cover display and instructions for using AR-based Student Worksheets can be seen in Figure 4.

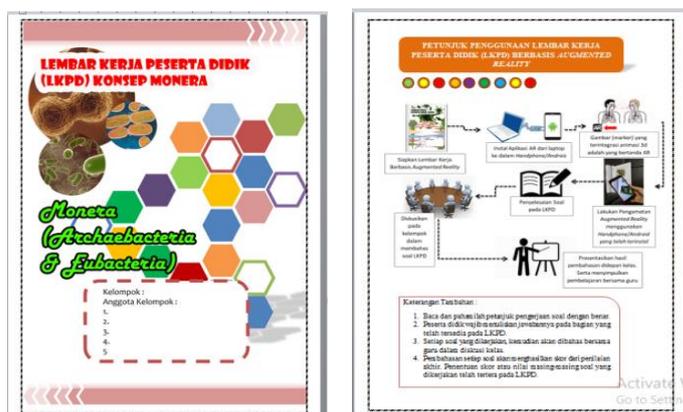


Figure 4. Design of cover and instructions for using student worksheets

The design of the Cover is made as attractive as possible so that it can attract the attention of students to using that Student Worksheet. So that students become more enthusiastic in the learning process. Appearance is very important in Student Worksheets so that students are interested and increase the motivation of students

to do the tasks that are in the Student Worksheet as report by Depdiknas (2008). On the cover contains the title of the Student Worksheet as a whole per Basic Competence and the identity column of the learning group of students. Instructions for using Student Worksheets based on Augmented Reality contain instructions for students how to using the Student Worksheet design results. The existence of instructions in the development of teaching materials aims to facilitate the use of teaching materials (Prastowo 2014). The design of the contents of the Student Worksheet is then part of the concept map and the first page. The design can be seen in Figure 5.

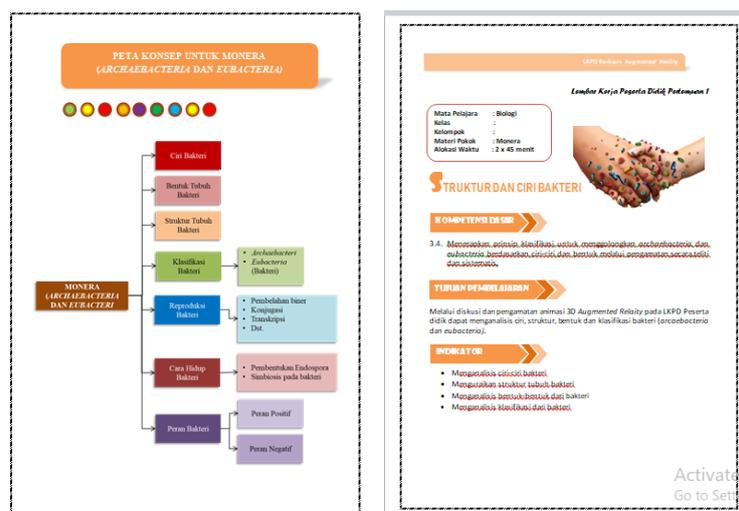


Figure 5. Draft Concept Map and First Page AR-based student worksheet.

The concept map page contains a description of the material to be studied in each basic competency, so that it can direct students to know what will be learned for each basic competency. Concept maps are given to formulate learning materials to be learned so that learning objectives can be achieved effectively as report by Marno (2012). The systematics of each Student Worksheet based on Augmented Reality begins with the title according to the meeting, then continues with identity, Basic Competency, Learning Objectives and Learning Indicators. The next page contains theories or discourses related to learning material as well as tools and materials needed in learning. Basic competencies and learning objectives are important things that must be in the Student Worksheet so that students know what competencies and learning objectives are to be achieved (Prastowo 2014). The design of the contents of the next Student Worksheet is part of the theory, tools and materials as well as work steps. The design can be seen in Figure 6.

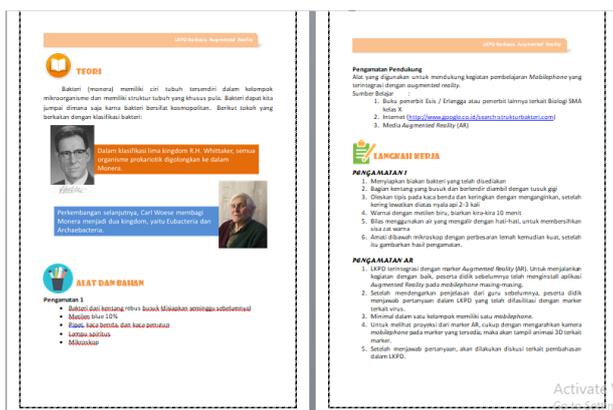


Figure 6. Draft Page Theory, tools and materials and work steps

The theory page is a page that contains the basic theory supporting the learning process, which helps students to add theoretical insight into learning. The parts of the tools and materials on the Student Worksheet contain what tools and materials are needed during the learning process that will take place. Then the work steps section contains directions or instructions in the activities to be carried out. The work step aims to direct students about how to use Augmented Reality technology that is integrated in student worksheets. After the work step the next part of the student worksheet is the observation of Augmented Reality. Various information, images, 3D animations that are on the worksheet of students are packaged with various colors to attract the attention of students in learning and improve the memory of students related to what is being learned. Using contrasting colors on information that is important in a media can be better remembered by the brain as report by Hendripides and Hikmah (2018). This observation section contains images that become markers of the 3D animation of AR biological objects studied.

The core activity on Student Worksheets based on Augmented Reality (AR) using the Discovery Learning (DL) syntax begins with stimulation and Problem Statement activities. The design of the page view can be seen in Figure 7.



Figure 8. Design of a Data Processing Page

Figure 8 shows the design stages of learning are Data Processing, Verification and Generalization. At this stage various questions have been prepared in accordance with the indicators and learning objectives to be achieved. Learners can answer available questions with the help of Augmented Reality 3d animation observations and verification from other references. The questions stimulated the students to critical thinking and integrated what they had been seen in the 3D and how to answer the question based on that facilities. The critical thinking will be need in this worksheet to stimulated student's mind as report by Isra et al (2018). After completion, students can conclude what has been learned at the end of the learning stage. Observation of Augmented Reality contained in Student Worksheets designed in monera material can be an alternative teaching material that can be used at school. Based on the results of observations of monera material studying the characteristics of bacteria, the structure and shape of bacteria, classification of bacteria, reproduction of bacteria and the role of bacteria in life.

This abstract monera material is usually implemented with practicum in the school laboratory. The results of observations in several schools indicate that there are schools that rarely use laboratories due to limited time constraints and limitations on tools and materials. So that the use of AR-based Student Worksheets can be an alternative to solving these problems. One of the 3d animation designs that can be displayed on AR-based Student Worksheets can be seen in Figure 9.

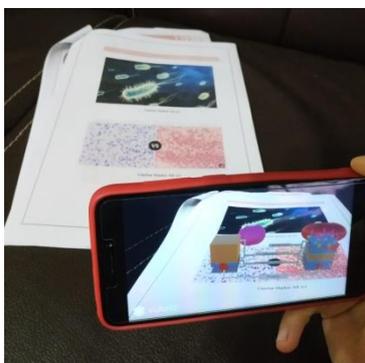


Figure 9. Display of 3D Augmented Reality Animation Design Results

The stages in using Student Worksheets Based on Augmented Reality (AR) in the research conducted can be described as follows:

1. The results of three-dimensional animation integrated with markers that have been made and packaged in the form of applications for android / mobile phones can be installed first.
 2. Applications that have been installed or installed on the Android / mobile phone can be used. How to use the application just by opening the application, after that the camera's active display will come out.
 3. Cameras for augmented reality applications that have been active can be directed to markers that have been integrated in the student worksheets.
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The advantages of Augmented Reality are as follows: 1) More interactive, 2) Effective in use, 3) Can be widely implemented in various media, 4) Modeling objects that are simple, because they only show a few objects, 5) Making that does not take too lots of costs, 6) Easy to operate as report by Mustaqim & Kurniawan (2017), Malinka & George (2011), Ady (2014). Sanikov et al (2015) report that AR is a promising and effective technology that enables better understanding of theory and facts and supports creative thinking and development of more realistic 3D models and scenes that can increase students' motivation in taking lessons.

The development of the learning process began to develop from very conventional and very dominant with very monotonous methods so that students became bored and less interested in following the learning process, then developed various methods and teaching media that supported the learning process to the use of technology in the learning process. If you draw one of the comparative examples of the development of teaching materials or media that previously only used a print or ppt image that only displays two-dimensional images, now the image can be visualized into a 3D shape. This of course increases the teacher's competency in facing the current era of innovation, besides that students will be more interested in participating in the learning process.

Research related to AR both in terms of development, acceptance and effectiveness in education continues. Some previous studies have shown that AR has good potential in education that can increase learning motivation or student learning outcomes because of the positive response of students to the AR media as report by Chen et al (2013), Ady (2014), Wenggita et al (2016), Suhertian and Risa (2012), Yuliono et al (2017).

4. Conclusion

The out come of this research is the design of Student Worksheets based on Augmented Reality (AR) on monera material. The student worksheet was integrated with 3D object of biology specific on monera concept. So, students can see the object of biology that have a small size directly with that technology. The research were expected to be developed and carried out further testing for students.

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