The appropriateness of developing the media: experts’ validation and students’ response of learning media based on augmented reality technology for natural science lesson

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Abstract. The development in science are so rapid in this era. Many experts exploited medias with new technologies in science learning based on the development of 21st century education. Technology is used as innovative learning media, that can follow the times. Technology which is integrated in learning is strategies for achieving learning purposes. This research is conducted to develop and find out appropriateness of learning media based on augmented reality technology for natural science lesson. The media was validated by the experts and science teachers. The samples were 30 of 8th grade students. The method was descriptive quantitative and the instruments were validation sheets and student questionnaires. Based on the results, it shows validation of media is 83%, subject 82%, language 87%, and from teachers are 88%. While the results of evaluation stage are 91%. It can be concluded that is suitable to used as learning. Then, this media can be used for science learning process in classroom and can be used for teachers as a reference for developing other learning media.

1. Introduction
The benefit of media that used for science learning according to the development of the 21st century is the media that using the latest technologies. Moreover, consideration that the development of science is so rapid now on. However, the use of learning media is not optimal. In the learning process the teachers often are very active and students are the opposite. Students only receive and follow explanations from the teachers. One of the student’s saturation is the use of monotonous and less interesting learning media. Another problem that often happens in the field is the limited skills of teachers in using and developing media, limited facilities and infrastructure in schools, and the limited availability of learning media itself.

The teacher only provides knowledge to students in the learning process. The teacher can help this process, by means of learning, designing information becomes more meaningful and more relevant to the needs of students [1]. Science lessons have the characteristics of having abstract and concrete subjects. Abstract subject tends to be microscopic like the structure of plant tissue. Abstract learning is caused of the lack of practice that given. Edgar Dale [2] made the classification of experiences from abstract to concrete, as his efforts to utilize media as a tool. The criterias for good learning media include 4 main things these are appropriateness, easiness, attractiveness and usefulness. In addition there are 4 characteristics of learning media, these are clarity of message, stand alone, user friendly and representation of content [3].
The using of technology media had significant influence on learning [4]. The development of Augmented Reality in the mobile phone industry also has the fastest development [5]. In addition, learning media Android-based can improve the utilization of mobile or tablet devices as learning media for students [6]. This is according to the research conducted by Jeng which shows that mobile technology has advantages, these are providing easiness in learning that is contextual, and according to the daily lives of students [7].

Chen stated in their study that, they reviewed the empirical Augmented Reality (AR) study in educational settings that published in the SSCI index journal from 2011 to 2016 and it had increased significantly since 2013. Researchers from Taiwan, Spain and the United States contributed most of the AR studies in education during 2011 to 2016 [8]. Saltan and Arslan stated in his research that, studies that provide evidence of increased academic performance, increased involvement, motivation, and student satisfaction through an educational environment that use AR applications [3].

Alkhattabi has a statement, the application of augmented reality shows good potential in learning process so that students can more active, effective and get the meaningful learning process [9]. Ferrer stated that the use of AR is suitable for anatomical purposes [10]. Concretely it helps to motivate students. Lee states that AR has the potential to encourage the efficiency of learning and training in the academic environment [11]. Based on the existing problems, the limitations of the media in science learning and based on previous studies, so researcher conducts the developing learning media based on augmented reality technology for science learning.

2. Methods

2.1 Planning Stage

At this stage, first stage is collecting information. Then, preliminary studies are used to determine the problems that exist in the field. After knowing the existing problems, doing the preparation of products that suitable with the needs. There are several things that are done in the planning stage are collecting references related to the media, choosing the design, preparing subjects as media evaluation.

2.2 Development Stage

In the early product development, the satage are making the story board of science learning media and the layout of augmented reality media, writing the subjects, making the handout and augmented reality applications, validation by experts (media, subject and language validators) and 2 science teachers and the next is revision.

2.3 Evaluation Stage

Evaluation stage is carried out after the product is revised. Quantitative descriptive research is used to find out and analyze the appropriateness of the development of media. The study was conducted in 2 public junior high schools in Ponorogo region in 2017/2018 academic year. The sample used was 15 students of 8th grade from each school, so it were 30 students as samples. The instrument was the student questionnaire sheet.

3. Results and Discussion

Media validation results from experts show the following results:

| No | Validated Aspects                                      | Score (%) | Category      |
|----|--------------------------------------------------------|-----------|---------------|
| 1  | The ease and clarity of media usage instructions       | 75        | Good          |
| 2  | The ease of use of the program                         | 75        | Good          |
| 3  | The media is according to the current development      | 100       | Very Good     |
| 4  | Regularity and harmony of color combinations used by the media | 75        | Good          |
| 5  | The images can help students learn                     | 100       | Very Good     |
Validation results from learning media experts can be seen in table 1. Judging from the average score obtained of 83% which means valid. The highest score is 100% lies in the aspect of the media in accordance with the times, the use of images, the ease of starting and ending the program, and also the media can be stored for a long time. This is caused this media is indeed a learning media that recently used in learning process, so it is accordance with the times. Sakat stated that technology is used as an innovative learning media that is believed can keep up with the times [4]. This media is also easy to use, in starting and ending students do not need difficult path that can be done by anyone. The images used also adjust the subject that students learn.

In addition, media with augmented reality technology can be ensured because it will not be damaged as the media in the form of charts, pictures or props. This is according to the statement from Mulyanta and Leong about 4 characteristics of learning media, these are clarity of message, stand alone, user friendly and representation of content [3]. For other aspects such as the ease of use of the program, the appearance, quality of text, video and images get 75% in score. This is caused the augmented reality media is very simple, not complex program. It is cause adjusting the subject that used, students' abilities and also the researcher’s abilities. For the next is the subject validation. The experts validation show the following results.

Table 2. The Result of Subject Validation

| No  | Validated Aspects                                                                 | Score (%) | Category |
|-----|-----------------------------------------------------------------------------------|-----------|----------|
| 1   | The subject presented in the media is according to the basic competence            | 75        | Good     |
| 2   | The media used are suitable for presenting the concept                             | 100       | Very Good|
| 3   | The use of languages and sentences in media is easy to understand                  | 75        | Good     |
| 4   | The science terms used in media are easy to understand.                            | 75        | Good     |
| 5   | The subject presented thoroughly                                                  | 75        | Good     |
| 6   | The depth of the subject presented can achieve learning purpose                   | 75        | Good     |
| 7   | The extent of subject presented can achieve learning purpose                      | 75        | Good     |
| 8   | The use of text and images is according to the contents of the subject            | 100       | Very Good|
| 9   | The subject presented can be found in everyday life                               | 100       | Very Good|
| 10  | The clarity of information in illustration                                         | 100       | Very Good|
| 11  | The level of difficulty of subject is according to the student abilities           | 75        | Good     |
| 12  | The suitability of practice / test with competence                                | 75        | Good     |
| 13  | The balance of the portion of practice questions / tests with subject              | 75        | Good     |
|     | Average                                                                          | 82        | Very Good|

The results of subject expert validation can be seen in table 2. There are 13 aspects that are validated. In some aspects the score is 75% and there are 4 aspects get 100%. The average obtained is
82% with very good category. The subject used in this study is structure and function of plant tissue subject. The researcher chooses this subject because this subject is really requires media as tool in the learning process. To find out the structure of plants, students must do practicum, while there are many tissues in plants. While the time allocated for this subject is not too much. To overcome this problem, this media is developed to help learning process in class or anywhere because it can be mobile.

The results of this study are consistent with the research conducted by Jeng which shows that mobile technology has advantages, it is providing convenience in learning that is contextual, and it is according to the daily life of students [7]. Students can use it anywhere, the time needed is short, and students can see all the structure of plant tissue with 3-dimensional video and images in it. Moreover, the advantage that noticeable of learning media based on android is its flexibility to be used anywhere and anytime without being bound by space and time. This advantage is supported by android devices that are small, light, and easy to carry anywhere.

This results were good enough, it gest an average score of 82% which means valid. The most prominent aspect that gets the highest score is this media is suitable for presenting the concept of the structure and function of plant tissue. This is very important, because not all science subjects can be applied in augmented reality media. In addition there are aspects of the use of text and images, and the appropriate subject also get 100% in score. It consist with research from Ferrer that the use of AR is suitable for anatomical purposes. Concretely it helps to motivate students [10].

Table 3. The Result of Language Validation

| No | Validated Aspects                                      | Score (%) | Category   |
|----|--------------------------------------------------------|-----------|------------|
| 1  | The use of Indonesian in accordance with EYD           | 100       | Very Good  |
| 2  | The use of languages is easy to understand             | 100       | Very Good  |
| 3  | The use of communicative language                     | 75        | Good       |
| 4  | The use of language can lead to understanding concepts | 75        | Good       |
| 5  | The clarity of the use of writing in handout and application | 100   | Very Good  |
| 6  | The language exploration in unity of handout design and application | 75   | Good       |
| 7  | The clarity of language usage in describing subject and information | 75    | Good       |
| 8  | The language compatibility with the level of thinking of students | 100 | Very Good  |
| 9  | The accuracy of text with subject                      | 100       | Very Good  |
| 10 | The effectiveness and efficiency in language use       | 75        | Good       |
|    | Average                                               | 87        | Very Good  |

Linguist focus on handouts more than application because there is more text in augmented reality handout. There are 10 aspects validated by linguist. Linguist more concerned with aspects of the use of language that are appropriate for EYD (enhanced spelling in Bahasa), easy to understand, communicative, clear, attractive, effective, efficient, and according to students thinking level.. Linguists more focus on handout, it caused more text in handout than in application. The language used in media is good, it can be seen from the average score obtained at 87% which means valid. There are no serious problems with the language used in augmented reality application and handout. This shows that this media already has the criteria for learning media, it is easy [4]. The ease, it means that learning content must be easily understood and learned by students and very operational in its use. The validator only suggests that the words which used must be more interesting, it is cause this media will be used by junior high school students.

Table 4. The Result of Validation from Teachers

| No | Validator | Score (%) | Media | Subject | Language |
|----|-----------|-----------|-------|---------|----------|
|    |           |           |       |         |          |
The teacher also conducts validation because the teacher is a person who plays an important role in the learning process. Therefore researchers also need validation from science teachers. Based on table 4, it can be seen that the average results of media validation get 86%, the average results of subject validation get 87%, and the average results of language validation get 92%, and each entry in the category very good.

These results indicate that the developed media is valid. The researcher asked the science teacher to do validation because the teacher had big contribution in the learning process. In addition, teachers have more experience about science learning media in the learning process that has been used, which is suitable for students, and the teacher also has experience in teaching science subjects. And from of languages, the teacher has experience and knowledge of good language that suits the students they guide. Students have to build their own knowledge by utilizing their brains to think in the learning process. The teacher can help this process, by learning, designing information becomes more meaningful and more relevant to the needs of students [2].

| No | Statements                                                                 | Score (%) | Category    |
|----|-----------------------------------------------------------------------------|-----------|-------------|
| 1  | The subject clarity in the media is very clear                              | 93        | Very Good   |
| 2  | The exploration of subject in the media to be studied                       | 76        | Good        |
| 3  | The ease of subject in the media to be studied                              | 96        | Very Good   |
| 4  | The clarity of writing in the media                                         | 98        | Very Good   |
| 5  | The clarity of language in the media                                        | 98        | Very Good   |
| 6  | The language attractiveness in the media                                    | 78        | Good        |
| 7  | The ability of media as learning resources                                 | 87        | Very Good   |
| 8  | The suitability of media with the needs of students                         | 87        | Very Good   |
| 9  | The ease of using the media                                                | 98        | Very Good   |
| 10 | The attractiveness of color combinations in the media                       | 94        | Very Good   |
| 11 | The design in the media                                                    | 96        | Very Good   |
| 12 | The clarity of images / videos / illustrations in the media                 | 96        | Very Good   |
| 13 | The attractiveness of images / videos / illustrations in the media          | 91        | Very Good   |
|    | Average                                                                     | 91        | Very Good   |

This evaluating stage is used to determine the appropriateness of the media that has developed. In table 5 it is shown that the results are very good, it get 91% in score, very good categorized and can be said to be very feasible to use. From the 13 aspects, there are 11 aspects with scores of more than 80% including subject clarity in the media, ease of subject in the media, clarity of text and language in the media, ease of media use, suitability for students, and attractiveness in design, color combinations, images / video / illustration. This already represents that the media can be concluded feasible use as learning media and according to requirements of good learning media. This is also according to in the research of Mulyanta and Leong, that the criteria for good learning media include 4 main things, these are appropriateness, easiness, attractiveness and usefulness. Besides that, it has fulfilled 4 characteristics of learning media, these are clarity of message, stand alone, user friendly and representation of content [4].

But there are 2 aspects that have below 80% in score, but it still in good category, these are the attractiveness of subject and the attractiveness of the language used in the media. This can be caused by the subject presented in the handout only about summaries, while the feature is more highlighted with 3-dimensional images with video information without long texts in the application. This learning
media is very simple, not complex media. For the attractiveness of language that doesn’t get the maximal value. It can be caused by the use of Indonesian language that is very adaptive of EYD. May be the students assume that up-to-date media is better to use relaxed and not rigid language.

Good student responses are seen from the enthusiasm of students in the trial process because students have very little knowledge about the latest learning media. It can be caused science teachers rarely use learning media especially in the form of applications in smartphones. In spite of negative effects, smartphones have been a very a great tool for supervising project's students and knowledge sharing [12]. This is in accordance with the statement from Saltan and Arslan, there is an increase of academic performance, involvement, motivation, and student satisfaction through an educational environment with AR applications [3]. Furthermore, this media is expected to be like the research of Alkhattabi which states that the application of augmented reality shows good potential so the students can more active, effective and get meaningful learning process [13].

4. Conclusion

The results of validation and trials are included in the category of good and very good, so it can be concluded that the media based on augmented reality technology is suitable to be used as a medium for learning science in subject structure and function of plant tissues. Then, this media can be used for science learning process in classroom and can be used for teachers as a reference for developing other learning media.

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