Multimedia Threed Exercise (Metriex) Based on 3D Modeling of the Baksoka Paleolithic Heritage to Improve Student's Historical Awareness

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Abstract—Ease of access to information if not used properly can eliminate historical awareness. On the other hand, easy access to information can provide information that is difficult to access to foster historical awareness. Historical awareness can be grown by presenting historical relics, especially at the school education level. But there is still less effort to present historical relics. From the data obtained at SMKN 5 Malang, learning has not been fully focused on developing historical awareness, because of the lack of use of technology so it is necessary to develop learning media that foster historical awareness. This research focuses on the development of learning media that can present historical relics in a real and easily accessible way to students. Through 3d modeling packaged in a smartphone application, this study aims to develop learning media regarding the paleolithic heritage of the Bakso River to foster historical awareness. This development is structured and packaged according to the needs of Class X students of SMKN 5 Malang. This study uses the 4D method and data collection in the form of observation, literature study, and interviews. Results Based on research on the development of historical learning media using effective 3d modeling.

Keywords—historical awareness, paleolithic of Baksoka River, 3d modeling

1 Introduction

Historical awareness is an awareness that exists in humans related to the value of a past event. At the educational level, history learning is aimed at creating situations to develop historical awareness[1]. Historical awareness is important as a vehicle for maintaining national identity, plus Indonesia is entering the information age[2]. This phenomenon leads to the information society. Information is the main resource, while information technology is the basic technology[3]. It includes production, consumption, distribution of information[4]. On the one hand, easy access to information, if not digested, eliminates historical awareness. On the other hand, it can be used to present information that is difficult to access to raise historical awareness. Therefore, history learning is required to be open to technological developments to present history as close as possible to students.

Based on data obtained by researchers at SMKN 5 Malang in January 2021, students felt bored with learning history. The use of media is only in the form of videos and PowerPoint through google classroom, both of which have not presented real history to students. On the other hand, the supporting facilities have met the needs, such as the easy use of smartphones and the internet. In addition, monotonous online learning causes students to be less enthusiastic about studying history, so they are less familiar with historical remains.

Specific to prehistoric or prehistoric materials, the need to present historical relics in an interesting and interactive way is important. Prehistory is learning material where understanding the events required efforts to understand the relics. This is because prehistory does not have a written source, so the only historical source is historical heritage. This is in accordance with the concept of post-processual archeology where the cognitive aspects of prehistoric humans are obtained from the study of artifacts or historical relics [5]. So there is a need for innovation in the field of history learning with the aim of overcoming problems and maximizing learning potential.

Recent research on digitizing historical relics is a common 3d modeling in engineering and archeology. For example Brutto[6] sparked the concept of modeling photogrammetry techniques in historic buildings or Bagnolo[7] with Unmanned Aerial Vehicles (UAVs). Both studies resulted in new concepts in the digitization of historical heritage but still cannot be presented in the learning process. Specifically related to learning, Saripudin[8] developing historical learning media based on 3d reproduction of cultural heritage objects. This research produces media that present real historical remains in the classroom, but the material is general, so the content is limited.

Regarding history learning, technological advances and advances in previous research, media are needed that foster historical awareness regarding prehistoric material. An alternative solution is to use 3d visualization with a smartphone application. This study aims to develop historical learning media that can present historical relics in a real and interactive way to help understanding and attract students' attention. The researcher presents the findings of the prehistoric paleotic heritage of the Baksoka River related to cultural and environmental aspects. Detailed knowledge is important to cultivate historical awareness. Therefore, the researchers developed learning media based on 3d modeling of the remains of the Baksoka River paleolithic tools.

2 Method

The method used in this study is the 4D research and development method proposed by Thiagarajan[9]. This method has four steps, namely define, design, develop, and disseminate. The definition stage aims to determine and define problems and development needs by conducting initial analysis, analysis of material limitations and student analysis. These processes are carried out to determine the development of the latest learning media, to find out the needs of students' learning media and the content of the material contained in the learning media. The design stage is intended to create a product development design. This is done by using the data conclusions that have

been obtained in the define stage. The design of the development product design is formulated into a specification of learning media. Thus, a design can be produced that is able to answer all the needs to be achieved.

The next stage is development. At this stage, the product development process is carried out according to the specifications that have been formulated. There are two steps taken, namely, validation of material experts and learning media. Material validation assesses aspects of the suitability of learning and aspects of the validity of the content of the material. While the media validation process assesses the physical, content, and evaluation aspects of learning media. The next stage is the dissemination stage where the product that has been developed can be disseminated. Products are distributed to students and teachers via google drive. These clear steps can describe in detail the development process.

Fig. 1. 4D development method

Data was collected using a questionnaire which can be divided into two types, media experts and material experts. The data consists of quantitative and qualitative data which will be analyzed by percentage analysis through the validity criteria of learning media. Metriex learning media will be valid if it reaches the minimum validity criteria. The criteria for the validity of learning media that become benchmarks include technical or physical quality, content quality, and evaluation quality[10]. Berikut adalah tabel kriteria pengambilan data dalam proses validasi produk pengembangan Metriex.

Table 1. Expert validation criteria

Tingkat	Kriteria	Keterangan
86%-100%	Very Valid	Very good to use
71%-85%	Valid	Can be used with minor revisions
56%-70%	Quite Valid	Can be used with major revisions
41%-55%	Less Valid	Cannot be used
25%-40%	Invalid	Cannot be used

3　Result and discuss

3.1　Media relevance in history learning

Efforts to teach and learn history are expected to continue to develop in line with the progress of the times. One of the developing phenomena is the increasing use of online learning in schools, including at the location of this research, namely SMK Negeri 5 Malang. However, the use of e-learning has not been filled with a variety of interesting and effective digital learning media. Learning media that generally exist are in the form

of power points and learning videos. On the other hand, with online learning conditions, students could access various related content and media. In addition, the use of smartphones is also already qualified, so that this potential will be in vain if it is not used in learning. Thus, the need for digital-based learning media is increasing, not only content but also on media packaging.

Based on the data obtained, 66% of students experienced boredom with online learning. This is because online lessons provide more assignments than interesting explanations about learning materials. This is understandable considering the limitations of fulfilling interesting and interactive learning media, especially on prehistoric material. So it is necessary to innovate varied learning media in order to attract students to want to learn. One of them is by developing digital-based learning media such as learning applications. Meanwhile, the current trend of developing learning media has begun to lead to digital-based media. This means that the development of Metriex media is in line with the reality on the ground.

From the results of observations and questionnaire analysis, it was concluded that most of the existing students tended to like digital-based learning. This is evidenced by 80% of all respondents saying that they are interested in digital-based learning media. In addition, from interview data with subject teachers, it is known that student motivation will be better for learning when using digital-based media. This is because students perceive digital media as "new stuff". This makes it easier for teachers to direct the learning process.

3.2 Paleolithic material of the Baksoka River in history lessons at vocational high schools

Paleolithic period material or hunting and gathering food at a simple level has been included in the framework of Indonesia's national history, which is taught in schools, including learning in vocational schools. In accordance with the concept of the order of Indonesian historical material, this material occupies the position of the initial material. Specifically in vocational learning, all materials in Indonesian history subjects are taught in class X. Likewise with the paleolithic period in semester 1 of class X, more precisely in KD 3.2. namely analyzing human life and the cultural outcomes of the Indonesian Praaksara community.

In the 2013 curriculum, the Paleolithic cultural heritage site of the Baksoka River has been mentioned in the SMK history textbook. A discussion of this material can be found on pages 50-51 of the revised 2017 edition of the student textbook. The narrative briefly discusses the stone tools on this site. However, the discussion has not been detailed and is not supported by complete pictures to clarify the existing relics.

According to Suprapta, the paleolithic site of the Baksoka River has a role as a supporter of learning media, especially history learning in relation to the socio-economic life of early humans during the hunting and gathering period at a simple level.[11]. Thus, this material is considered important in explaining the development of early human life in the Indonesian archipelago.

3.3 The use of 3d modeling in learning media

In simple terms, the concept of three-dimensional (3d) is an object that has length, width, and height with various shapes. The advantage of 3d is the visualization of objects that look more real, such as supporting shapes. The basic difference between 2-dimensional and 3-dimensional is that a 2-dimensional model only has length and width dimensions, while a 3-dimensional model has depth. So that 2-dimensional data objects are different from 3d which have volume[12].

Modeling or modeling is the process of digitally creating and designing objects so that they look like real objects. This process is completely done on the computer. Through the concept and design process, all objects can be displayed in 3 dimensions, so this result is called 3-dimensional modeling (3d modeling)[13]. 3d modeling activities are usually used in several fields such as architecture, engineering, and regional mapping.

One method of 3d modeling can use photogrammetry techniques. Santoso in Prastyo et al explained that photogrammetry or photogrammetry is the knowledge, technology and art of obtaining information about a physical object and its surroundings using the process of observing, recording, and interpreting photographic images or recordings of electromagnetic waves [14]. 3D modeling techniques with photogrammetry can be done with several kinds of software, one of which is used in this study is Agisoft PhotoScan.

In the context of modeling media, it is important to visualize an object. This can be seen from the advantages described earlier. Objects that are shown in 3 dimensions are clearer and can be captured well. In addition, digital-based 3d modeling can be easily disseminated. Therefore, in this study, we take advantage of the advantages of 3d modeling in terms of developing learning media.

The concept of three-dimensional modeling in this study is used to create three-dimensional modeling of historical heritage. The historical heritage in question is the paleolithic heritage of the Baksoka River. Through three-dimensional modeling, objects that are usually displayed in the form of 2-dimensional images will be processed into three-dimensional objects. The results of this modeling are in the form of digitizing historical heritage objects in three-dimensional form.

In vocational learning, the pre-literacy material is found in KD 3.2. namely analyzing human life and the cultural outcomes of the Indonesian Praaksara community. Specifically, this learning media contains paleolithic material which is part of the pre-literacy material. Therefore, the basic curriculum of material development in this media is KD 3.2. For this reason, this media was developed with certain specifications that can support the delivery of paleolithic material well to students.

3.4 Metriex learning media based on 3d Modeling of Baksoka River paleolithic tools

The specifications of the media in this study focus on the development of digital information media that can foster historical awareness. This is done by developing media in the form of applications that feature 3d modeling of historical relics, 3d maps,

material summaries and interactive quizzes for students. Metriex media includes explanations through writing, pictures and 3d modeling (maps and examples of relics).

Media Metriex begins with the initial display, namely the home screen menu. On the home screen menu, there are several buttons that direct students to the contents of Metriex media content. Some of the buttons include academic information, materials, 3d models, quizzes, and developer information. The function of the buttons on the main menu will direct students to the next menu which is called the main submenu.

Fig. 2. Display home screen and main menu

In the preliminary sub menu, there is academic information containing a description of information about basic competencies, learning indicators, and learning objectives. Furthermore, in the material sub menu, there is a description of the material left by the Baksoka River paleolithic tools. This section is accompanied by supporting images such as examples of tools, maps, and the natural landscape of the Baksoka River. The function of this supporting image is to clarify students regarding the discussion of the material presented. Thus, students can listen and understand the material well.

Fig. 3. Introduction and description of the material

The next is the 3d model sub-menu. This sub-menu contains 3d models of the Baksoka River paleolithic tools. This menu is intended to make it easier for students to identify the types of Baksoka River paleolithic tools. To be able to further explore the 3d model, students can directly shift the 3d model of the paleolithic tool. By sliding it students will be able to see paleolithic tools freely from various perspectives. So that students can find out in detail and thoroughly the examples of these paleolithic tools.
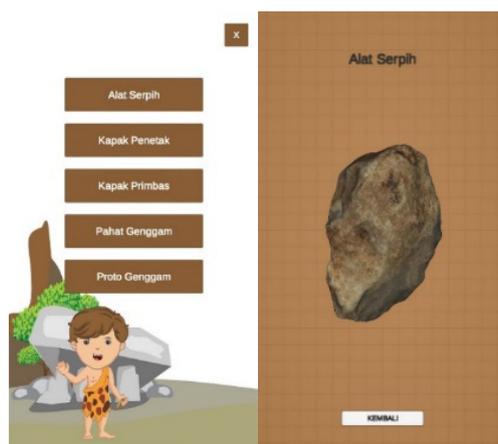
Fig. 4. Paleolithic tool 3d model menu display

In the next sub menu is a quiz that can be done by students. This quiz contains ten multiple choice questions that can be done directly by students. Existing questions are questions from the material that has been studied by students in the previous material menu. Each question is worth 10 points so that the total value of the full points on this quiz is 100 points. At the end, the total value of the correct answers that have been answered by students will be displayed**.**

Fig. 5. Quiz menu display

3.5   Metriex learning media products testing

In this research, product testing was conducted in the form of material validation and learning media using expert validation questionnaires. This process aims to measure the level of validity of the learning media so that it can be seen the level of feasibility of the developed media. The assessment of this product material is based on two aspects, namely, the learning aspect and the content aspect. Based on the data from the validation of the material by Dr. Henry Praherdhiono, S.Si., M.Pd, an expert on learning media at the Faculty of Education, State University of Malang, obtained a score of 45 from the total maximum score of 48, this data is then calculated to determine the percentage of material validation values based on the percentage formula and the criteria proposed by Akbar Sa'dun[15]. The result is the Metriex learning media has a material validity level of 93.75 so it can be categorized as very valid. The following is a material validation table by material experts.
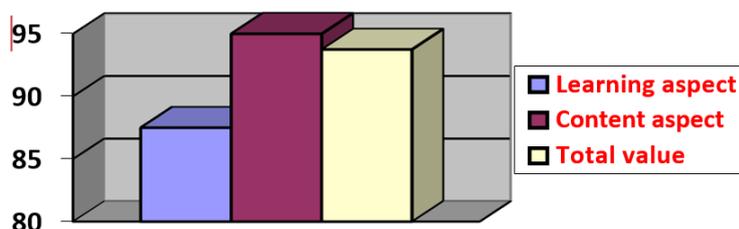

Fig. 6. Material validation testing by experts

The assessment of this product media is based on three aspects, namely, technical aspects, evaluation aspects and content aspects. Based on the material validation data, a score of 61 was obtained from the maximum number of 64, then the data is calculated to determine the percentage of media validation based on the percentage formula and criteria proposed by Akbar Sa'dun [15]. The result is the Metriex learning media has a media validity level of 95.31 so it can be categorized as very valid. The following is a material validation table by material experts.
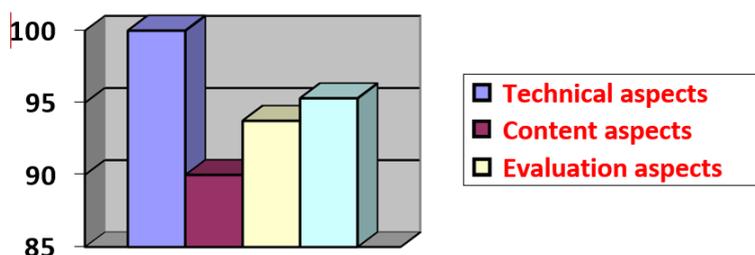

Fig. 7. Media validation testing by experts

After going through a series of validations in this study, history learning media was produced in the form of an android application for history subjects. The media is designed, created, and validated by experts. The use of this media in history learning is a new alternative to history learning.

The Metriex learning media prioritizes the use of technology in packaging historical heritage objects, especially the paleolithic tools of the Bakso River. As it is understood that historical learning resources are abundant in the era of information and communication technology, teachers and students have the opportunity to teach and learn history creatively [16]. Therefore, the use of technology is a necessity in teaching history.

The goals of historical education conventionally consist of four groups of goals, namely the development of historical thinking and historical skills, historical knowledge, and attitudes as citizens.[17]. To support this goal, this learning media was designed and developed by prioritizing the development of 21st century technology by presenting the concept of 3d modeling combined with android applications. So, it is hoped that this learning media can develop students' historical awareness through various features in it.

Historical awareness must be instilled in the millennial generation creatively and innovatively to be accepted. Teachers can use various existing sources, such as historical sources in the form of objects in the process of extracting students' views on history [18]. Therefore, Metriex learning media has developed a creative and innovative way to increase historical awareness. Through the depiction of historical relics in the form of 3d modeling, teachers no longer have difficulty presenting historical relics in the classroom. The impact is that students become more understanding of history and then awareness of history arises.

4   Conclusion

One of the efforts to raise historical awareness is by presenting historical relics in a real and interactive way, especially at the school education level. One of them can be reached through the development of learning media based on 3d modeling. By three-dimensional modeling technology, a learning media can be produced that is able to present historical relics in a real and interactive way to students. In addition, by packaging three-dimensional modeling of historical heritage with applications on smartphones, it can make it easier for students to access. So that it can improve the quality of history learning in the digital era. While in the process of testing the learning media Metriex has a very valid level of validity both in terms of material and learning media. For this reason, Metriex learning media can be used in the classroom learning process.

5 Acknowledgment

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