History visualization using augmented reality

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Abstract. Augmented reality is an interactive digital media where objects in real-world environment is visualized through a computer-generated image. This research aims at developing an application to visualize abstract historical objects into more concrete objects so that it can be used as an instructional media. The development was done using Web Aurasma Based Studio and Reveal Mobile in six stages including concept, design, material collecting, assembly, testing and distribution. The results showed that the developed augmented reality application was highly effective in visualizing historical facts so as to motivate students in studying historical facts in a more real and concrete way.

1. Introduction

Today's information and communication technology is growing rapidly and bringing major changes in various aspects including education, which is a key factor in improving the quality of human resources. The rapid advancement of digital technology must be able to be fully utilized to support the learning process in the classroom because digital interaction has changed students’ mindsets and behaviours both in learning and social interactions [1].

The 21st century education requires the integration of technology in the learning process. Therefore, the advancement of cellular technology such as tablets, smartphones and gadgets with sophisticated and more complete features should be fully utilized to facilitate the learning process. Smartphones and other digital devices can be powerful instructional media both inside and outside the classroom [2].

One of recent technologies that can facilitate the learning process is augmented reality (AR). It is a combination of the real world and virtual world by means of computers so that the boundary between them becomes less distinct. To put it simply, AR can be defined as a real environment added with virtual objects. AR can be designed using desktop or mobile computers [3]. In terms its marker, AR can be divided into image-based AR and location-based AR [4].

Studies show that AR can be developed into various applications such as games [5] and books [6, 7]. AR can also be used for instructional purposes and has been proven to facilitate students’ understanding about teaching materials in many classrooms of various academic disciplines such as electricity [8], physics [9], and computer programs [10]. It is also suggested that AR can help student understand abstract concepts [11]. Based on this description, this research attempts to design an AR for use as classroom instructional media.
2. Method
Using a design-based research approach as suggested by Sutopo [12], we designed an instructional media in six stages: concept, design, material collecting, assembly, testing and distribution, and evaluation as illustrated in Figure 1.

![Figure 1. Sutopo’s development model.](image)

3. Result and discussion

3.1. Concept
At this stage, data were collected through observation and interviews with history teachers. The purpose was to identify users and determine application type and use. At this stage we:

- determined the purpose of instructional media use,
- analysed to what extent instructional multimedia was used in school,
- identified users’ characteristics through classroom observation and interview with the teacher, and
- assessed students’ technological savviness.

3.2. Design
AR was designed in accordance with the needs of the users, students and the history teacher. The program designing began with preparing the contents, setting the content presentation, and designing the learning flowchart. In short, the designing was done through the following steps:

- writing the text to be presented in the AR as instructional materials; in our case, we prepared the history of Indonesian national anthem Indonesia Raya,
- designing the learning flowchart,
- designing the media screen,
- preparing the contents that consisted of marker in the form of flashcard and instructional materials in the form of video, and
- naming the developed AR to make it easier for students to search for interactive multimedia on Aurasma.

3.3. Material collecting
The following materials were collected to develop the AR:

3.3.1. Picture. A freely distributed picture was downloaded from the Internet to be used as a marker. The picture was then modified using Adobe Illustrator CS5.
3.3.2. Video. The process of video development was done using Adobe After Effects by combining several components including video and audio. The resulted file was saved as MP4. This is to ensure that the file format is compatible with the application (Aurasma).

3.4. Assembly
AR was developed using Aurasma/hp reveal through the following procedures:

- select the downloaded picture in order to be used as a marker,
- insert the selected picture into Aurasma Studio,
- select video,
- insert animated video in order to be used as the AR content, and
- assign a name to the developed AR so as to make it searchable on Aurasma.

3.5. Testing
Once the development process was done, the next stage was testing. This is to verify if the application can run well. The test was carried out by changing the distance between the marker and the AR-installed smartphone. The results are presented in Table 1.

| No | Distance | Status                                        |
|----|----------|-----------------------------------------------|
| 1  | 10 cm    | AR content appears                            |
| 2  | 15 cm    | AR content appears                            |
| 3  | 20 cm    | AR content appears                            |
| 4  | 25 cm    | AR content appears                            |
| 5  | 30 cm    | AR content appears                            |
| 6  | 35 cm    | AR content sometimes appears, sometimes does not |
| 7  | 40 cm    | AR content sometimes appears, sometimes does not |
| 8  | 45 cm    | AR content does not appear                    |
Table 1 shows that the smartphone can display the AR content provided that its distance to the marker is 10-30 cm. In a 35-40 cm distance, the content may appear and may not. The smartphone cannot display the AR content within 45 cm or more because the camera cannot clearly capture the marker.

Figure 4. Testing.

3.6. Distribution

The distribution stage is the process in which the AR application was printed on paper in the form of flashcard. The reason is that flashcards are simpler than books or other instructional media.

Augmented reality is used to display information about the history of Indonesian songs in the form of learning videos for. On making this Augmented Reality application uses the Marker Based Tracking method. Augmented Reality requires a webcam for capture marker images, if the marker reads well a virtual object will appear in the form of video or animation [13]. Testing of the application obtained several conditions, including the system can detect the marker perfectly in the range of distance between 10 - 30 cm from the camera. The system cannot display objects above the marker if the marker is blocked by other objects in the real world so that the marker cannot be recognized. Learning by using Augmented Reality is effective in helping students, they are moving from instructed-learning to a self-centred learning method [14].

4. Conclusion

Based on the result of the research, we conclude that the smartphone can display the AR content provided that its distance to the marker is 10-30 cm. In a 35-40 cm distance, the content may appear and may not. The smartphone cannot display the AR content within 45 cm or more because the camera cannot clearly capture the marker. We conclude that in a 10-30 cm distance AR can be used as an alternative classroom instructional media. The video in the AR can facilitate the learning process and may motivate students to engage in the lesson.

Acknowledgments

This publication is made possible by the financial support from Institut Pendidikan Indonesia.

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