Tracking Javanese Cultural Heritage through Augmented Reality and its Implications in Indonesian Language for Foreign Speakers (BIPA) Learning

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Abstract

The development of Information and Communication Technology (ICT) in cultural heritage (CH) shows a very large impact at this time. In particular, it is about cultural heritage development uses the Augmented Reality (AR) technology. This study aimed to digitize the aspects of Javanese cultures (traditional clothes, houses, and weapons) and its implications in learning of Indonesian Language for Foreigners (BIPA). This current research used Thiagarajan 4D research and development design. The research was conducted through four (4) stages namely define, design, develop, and disseminate stages. The Augmented Reality development implemented the virtual buttons on each marker. Some markers were designed by using the Vuforia Software Development Kit (SDK). The 3D Unity and the Vuforia Engine SDK were used as the platforms to develop Augmented Reality software. The 3D objects were designed using the 3D blender app to imitate the traditional clothing, houses, and the traditional weapons. The results showed that this product has good sensitivity and is proven to be able to imitate object images. In addition, this product has implications and is interesting to use in the intermediate-level of BIPA learning on the cultural aspect. This research is important to do in addition to maintain, preserve, digitize the cultural aspects, as well as introducing Indonesian culture to foreigners.

Keywords

Cultural Heritage, Augmented Reality, BIPA Learning, Indonesian Language, Information and Communication Technology (ICT).

1. Introduction

At the beginning of the twenty-first century, adaptive and interactive technologies are transforming various sectors. Information and Communication Technology (ICT), if used in the right way, can provide enormous opportunities for both urban and rural areas (Mariani et al., 2014). In addition, the development of information and communication technology is used and utilized in various sectors to increase effectiveness, roaming, and other conveniences (Love & Matthews, 2019). For example, the use of technology with tourism (Buhalis & Law, 2008; Januszewska et al., 2015), enterprise (Lukina et al., 2020), urban planning (Rathore et al., 2016), logistics delivery services (Chen et al., 2009), fashion (Bertolini et al., 2018), education (Lai & Bower, 2019), health (Attaran, 2020), business (Wilburn & Wilburn, 2018), sports (Kos et al., 2018), social services (Johnson & Wetmore, 2021), transportation (Jamil et al., 2020; Prananda et al., 2020), and many more.

The development of Information and Communication Technology can also transform various classic or ancient things with the present (Hansen et al., 2018), as a touch of technology in the cultural heritage. The development of ICT in cultural heritage (CH) shows a very large impact at this time. ICT changes the way of seeing the ancient places or cultural heritage (Voinea et al., 2018). These changes lead to modifications of several procedures, methods, and applications (Owen et al., 2004) as well as changing the way to visualize, experience, and think in conceptual and operative relationships with real content (Brusaporci, 2020). Therefore, technology is now becoming recognized as one of the important components of the cultural sector (Di Pietro et al., 2015).

Today, cultural heritage is an important asset of a nation. Cultural heritage becomes a unique identity and is unique to every nation and country (Floria, 2019). Culture and cultural heritage are the most important foundations for creating and maintaining the values of identity, belonging, and citizenship. Culture has a fundamental role in human development and in the forming of identities and habits of individuals and communities (Di Pietro et al., 2018). Cultural heritage describes the characters, memories, assets, values, wisdom, and philosophy that provide the understanding and are inherited from the past but are also still relevant to the present (Jung et al., 2018). This shows a strong affinity between the concepts of heritage, culture, and identity not only belonging to the country, region, locality, but also to oneself, family, and society.

The utilization of cultural heritage can help in preserving the past traditions and pass them on to future generations, increasing citizen awareness, and increasing the capacity of the community to identify themselves in heritage situations (Breathnach, 2006). Cultural heritage can educate, provide different meanings and experiences for different people. In addition, cultural heritage can also spread cultural values and generate new resources (Lee & Chhabra, 2015). Cultural preservation emphasizes the need to protect and restore all forms of cultural diversity, recognizing the many strands of culture such as languages, arts, buildings, dances, folklore, crafts, sacred places, and more.

Indonesia is a very rich archipelagic country. Wealth is not limited to natural products, but also to various ethnic groups, languages, religions, beliefs, and customs. In addition, there are thousands of ethnic groups living in various regions such as Sumatra, Java, Kalimantan, Sulawesi, and Papua. This shows the many unique cultures that need to be protected and preserved. One of the tribes in Indonesia is the Javanese. The Javanese are one of the largest ethnic groups in Indonesia and are rich in culture, both material and intangible. According to data from the Statistic Indonesia (Badan Pusat Statistik, 2012), the Javanese are the largest ethnic group with a proportion of 40.05 percent or about 95.2 million people from the total population of Indonesia.

In recent years, innovative and exciting applications of technology in the cultural heritage sector have emerged. This phenomenon has dictated rapid and substantial changes in the practice of using, providing and preserving cultural heritage (Guccio et al., 2016). The technology focuses on the use of websites (Bahry et al., 2022; Nishanbaev, 2020), android (Purwanto et al., 2021), Atalaya 3D (Melero et al., 2018), GPS finder (Sharp et al., 2019), mobile devices (Subali et al., 2018), mobile applications (Jung et al., 2018), and so on. The widespread use of this technology has enriched and made information more accessible to various segments. Through this communication technology, additional information can be shared with visitors, thus becoming a focal point of added value for cultural heritage.

One of the interesting technologies to use in cultural heritage is Augmented Reality (AR). Augmented Reality (AR) is one of the most promising and cutting-edge technologies in modern times, its development and implementation in CH may be an opportunity to increase competitiveness (Attila & Edit, 2012). AR is becoming an innovation by

presenting real-world images with increased computer-generated content that is connected to certain places (Choi, 2014). In other words, AR allows digital content to be easily superimposed and blended into our insights and conceptions of the real world. AR has three characteristics, namely displays that combine the real world with virtual worlds, can use 3D perspectives, and interact according to the frame. AR enables a fundamentally more engaging user experience and enriches content. Through AR, users can explore and find new information in objects.

The use of AR in various areas of our daily life has attracted the interest of many researchers. Billinghurst applies AR in education (Billinghurst, 2002). AR is also an interesting integration in medicine (Eckert et al., 2019). Vilkina and Klimovets proposes AR as a marketing strategy in a competitive global market (Vilkina & Klimovets, 2019). Nee, Ong, Chryssolouris, and Mourtzis use AR for design and manufacturing (Nee et al., 2012). Paelke uses AR to support industrial ecosystems (Paelke, 2014). AR is also a technology in the cultural preservation sector (Casella & Coelho, 2013; Damala et al., 2012).

In Indonesia, AR is also used in cultural heritage. For example, in digitizing traditional Sundanese musical instruments (Arifitama, 2017; Arifitama & Syahputra, 2017), digitizing Malang masks (Pramono et al., 2020), and preserving Javanese folklore (Permatasakti & Basiroen, 2018). However, there are not many studies in Indonesia that use AR for cultural heritage to collaborate with educational aspects.

1.1 Objectives

This study aims to digitize aspects of Javanese culture (traditional clothes, traditional houses, and traditional weapons) and their implications in learning Indonesian Language for Foreigners (BIPA). This is important to do in addition to maintaining, preserving, and digitizing cultural aspects, it can also be used to introduce Indonesian culture to foreigners.

2. Literature Review

Cultural heritage is more than just an object. Cultural heritage represents institutions, values, and wisdom in life, and can even be considered a national treasure. Modern technology is very interesting and has become a breakthrough as a new method for preserving, documenting, and exploring CH. The Augmented Reality (AR) become one of the choices for cultural heritage because AR enable us know how the form of that culture. AR is not just 2D or 3D images, it makes it easy to promote culture in this modern era. Augmented Reality (AR) being one of the most promising and cutting-edge technologies in modern times, its development and implementation in CH may be an opportunity to increase competitiveness (Attila & Edit, 2012; Jung & Han, 2014).

3. Methods

This study implemented a 4D Thiagarajan research design (Thiagarajan, 1974). The research starts from the define, design, develop, and disseminate stages. However, in this case, the research procedure will be carried out until the development stage. This is because the dissemination process takes a long time. The first activity was to collect data and information related to Javanese cultural heritage, such as traditional clothes, traditional houses, and traditional weapons. Data and information are the main ingredients for making AR applications.

The second activity was to design the 3D objects. This activity was conducted after analyzing the previous collected data and information on traditional instruments which helps in determining hardware and system requirements and also helps in defining the system as a whole. This stage was carried out by conceptualizing various content and features that will be developed. In this study, three forms of the instrument were designed in 3D to imitate aspects of digitally documented cultural heritage.

The third activity was to develop an Augmented Reality-based application and applying virtual buttons to each marker. Some markers are designed using the Vuforia software development kit. The 3D Unity and the Vuforia Engine SDK are used as platforms to develop Augmented Reality software. The 3D objects are designed using the 3D blender app, to imitate custom clothing, houses, and weapons.

4. Data Collection

This research belongs to the type of development research. Data collection in this research is carried out when the process will develop Augmented Reality. The data collection is carried out by recording and collecting images of

objects that will become a representation of Augmented Reality, such as pictures of traditional houses, traditional clothes, and traditional weapons.

5. Results and Discussion

In creating the Augmented Reality-based Java Culture App, various references and designs are first determined. This part was done by setting up the application workflow. This workflow was started by opening the application until exiting the application. In the flow, there is an explanation of the sequence of using the application. However, in this plot, several steps are explained because it shares common features, so it only needs to be repeated. When running the application, the user shoots an image of the target or marker by using the camera to produce a 3D appearance of the object. Figure 1 is an application workflow chart that has been designed.

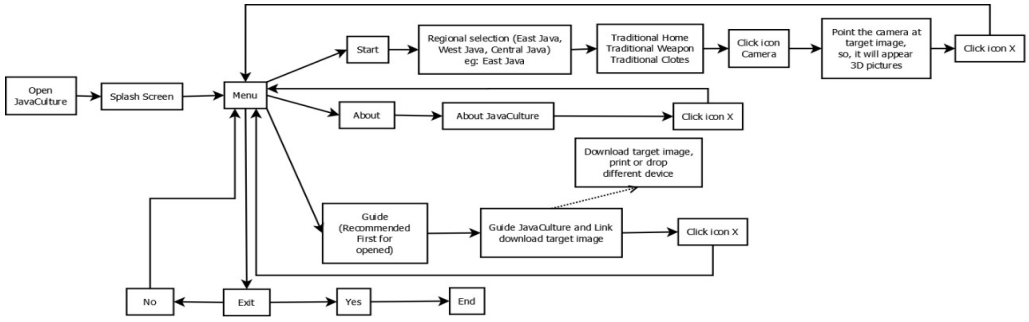


Figure 1. Application workflow

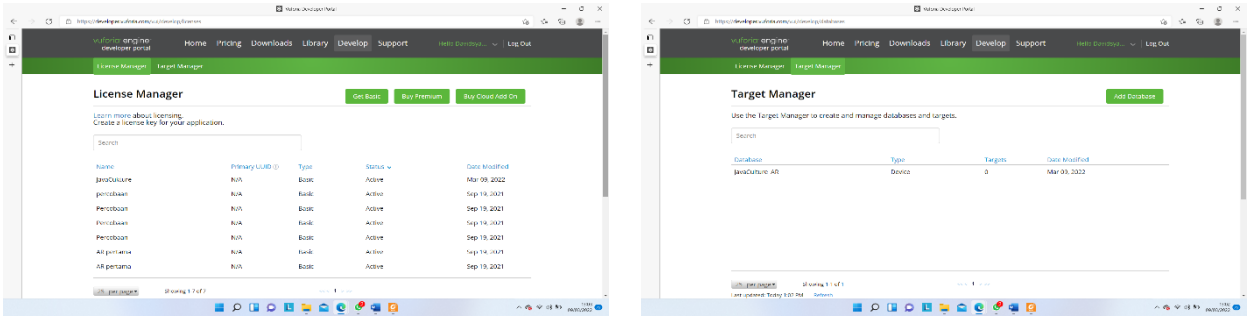
The next process is to prepare images related to the Java Culture. The target images used in this development include images of traditional houses, weapons, and clothes. In this development, nine (9) target images consisting of 3 images of traditional houses, 3 images of traditional weapons, and 3 images of traditional clothing are used.

(a) (b) (c)

Figure 2. Target images (A. Custom clothing, B. House, and C. Weapons)

The next step is to upload the target image to Vuforia so that it can be used as an AR target image. This website will also be able to check the sensitivity of the image to display 3D images (AR). The initial step is to open the *developer.vuforia.com website*. To enter this website, either registration (if you don't have an account) or login (if you already have an account) is required.

After logging in, the user will face two choices, namely License Manager and Target Manager. The License Manager is used to obtain a license key so that it can connect with Unity 3d, while the Target Manager is a place to upload target images that are used for AR targets. The display can be seen in Figure 2.

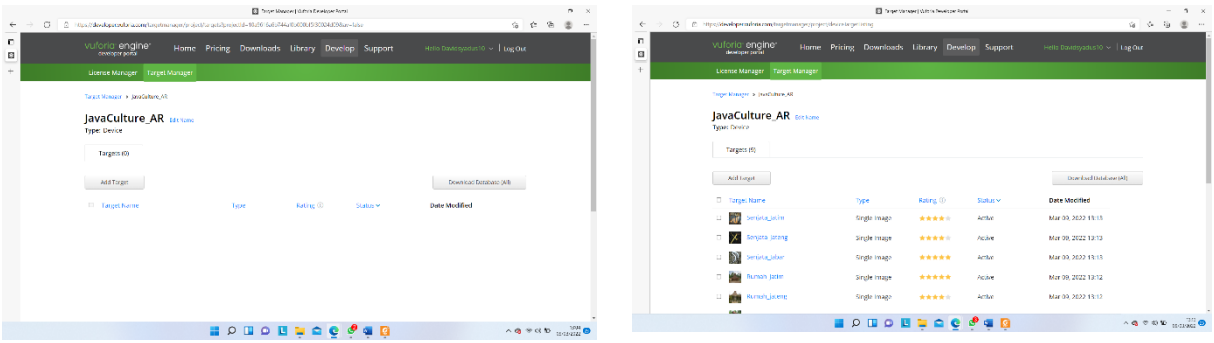


(a) (b)

Figure 3a. Display of License Manager and 3b. Target Manager

License Manager (see Figure 3) must create a new license to avoid data collisions by clicking the Get Basic button for free ones and Buy Premium for paid ones. In this development using the free part. After completion of manufacture, it will appear on the license list, see Figure 2. To get a license key, click the name of the license that has been created after that a license key will be listed on the web display, this license key is used in the Unity 3D application.

In the Target Manager, a new database will be created containing the target image that will be used as an AR target. Add Database Button is used to create a new database. To insert the target image into the database, first enter the database that has been created. In this view, the target image will be inserted, namely by clicking the Button Add Target. Once uploaded, it will appear on the list, see Figure 4b. On the list, there is information about the rating symbolized by a star. This rating is used to determine how sensitive the target image is to display AR objects. The fewer ratings, the more difficult it is to display objects, while the more ratings, the easier it is to display AR objects.



(a) (b)

Figure 4a. The view after entering the database and 4b. The view of the target image list

Figure 5 shows the uploaded target image that will be used on AR targets in this study starting by traditional houses, weapons, and clothing. The rating of all target images has 4 and 5 out of a range of 5, which means this target image can display 3D objects (AR) easily and has a relatively high sensitivity. If the upload process is complete, the further step is downloading the database that has been created for later use in the merging process (AR) in Unity.

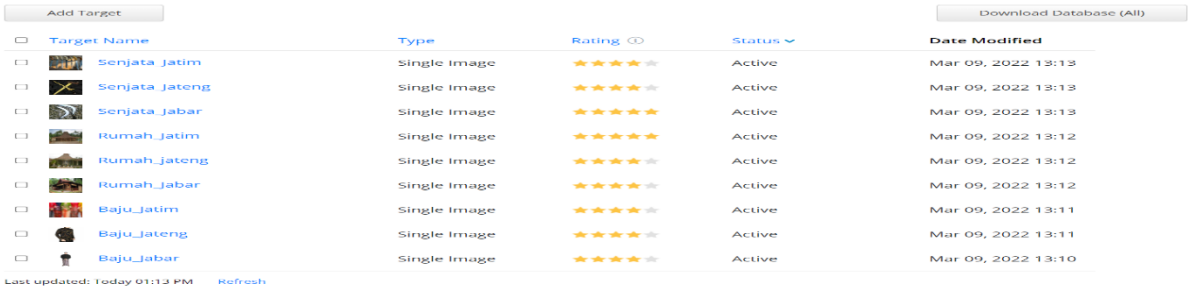


Figure 5. Rating results from the target image

The 3D images in this development are designed using the Blender application. This 3D image can also be referred to as an imitation of traditional houses, clothes, and weapons. These artificial images will later be used as an asset in the coding stage. Figure 6 shows the 3D images (artificial images) used in this study.

(a) (b) (c)

Figure 6. 3D design (imitation) of A. Traditional clothes, B. Houses, and C. Weapons

Having the assets are collected, both the target image and 3D image, the next stage is merging both by using Unity. In Unity, AR will be created because in unity already available AR Camera so it was easier to create. With the existing features, it can be enabled to combine 3D images that match the target image that has been determined. For example, the image of traditional clothing must match the image of the target of traditional clothing, so that when the target image is shot with the camera by the user, a 3D image of traditional clothing will appear. Figure 7 below illustrates the placement of 3D objects on the marker (target image) done in the Unity app.

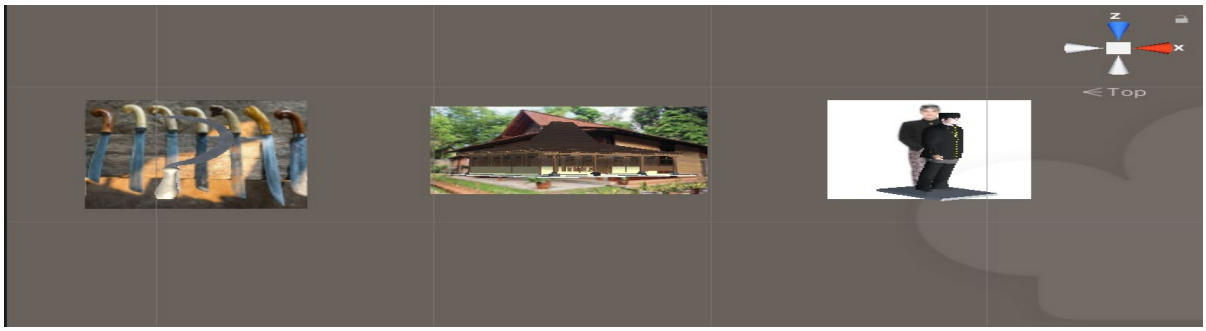


Figure 7. Placement of 3D objects on markers using Unity

Figure 8 shows the result of making the AR. The result is the piloting carried out by the user aiming at a target image area so that the 3D image will increase or appear above the target image. This can be done from various angles as long as the target image is still visible at least 40%-50% of the target image. Users can only see 3D images of rotating traditional clothes, weapons, or houses.

Figure 8. Augmented reality custom clothing, weapons, and houses

5.1 Implications of Research Results on Indonesian Language Learning in BIPA

The results of this development have implications for BIPA (Indonesian Language for Foreigners), especially aspect related to cultural knowledge. The main cultural materials that need to be introduced to BIPA students are cultural behavior, knowledge, and cultural objects.

Teaching BIPA has a crucial role in developing and maintaining a wealth of traditions and culture, especially in the form of works of art, tourism attractions, and culinary treasures. This is in line with the objectives of BIPA learning, which is to introduce and gain wider recognition both at home and abroad regional and international level related to the Indonesian language and culture. In addition, mastery of aspects of Indonesian culture is also an important part that needs to be considered and integrated into learning in accordance with the pedagogical norms of BIPA learning (Pratiwi, 2020; Suyitno, 2017).

In the Regulation of the Minister of Education and Culture of the Republic of Indonesia Number 27 of 2017, it is explained that material for studying cultural aspects is not specifically included in BIPA learning. Educators/instructors are given the freedom to identify and develop elements of Indonesian culture in accordance with the material presented. This is in line with the opinion of Suyitno who states that in BIPA learning, not all Indonesian cultural treasures can be reached through visits and observations (Suyitno, 2017). Cultural knowledge about the development of ethnic groups in Indonesia, the development of arts, religious systems, historical heritage objects, and superior works of art are cultural materials that need to be introduced to foreign students. Therefore, the development of the Java Culture application is an appropriate learning material in introducing aspects of Indonesian culture with a touch of technology to BIPA students.

Based on the Regulation of the Minister of Education and Culture of the Republic of Indonesia Number 27 of 2017, there are seven levels or levels used to identify students' abilities in BIPA learning. Each level has competence or achievement parameters. In addition, there are also levels of proficiency for BIPA students, namely beginner, intermediate, and advanced. BIPA 1 or Beginner (A1–A2), which is the level of students who are expected to have basic competence in using Indonesian in everyday conversation. BIPA 2 or Madya (B1–B2), which is the level of students who are expected to be able to use Indonesian orally and in writing for formal purposes. BIPA 3 or advanced (C1–C2), ie the level students are expected to be able to give opinions and reasons, participate in formal discussions, and write essays.

Development of this application can be implicated in BIPA learning with intermediate to advanced levels or in level 3 to level 7 with sub-competencies Actualizing the character and personality of BIPA students, elements of competence 1.3 Acting as citizens who are proud and love the homeland and support world peace, and indicators 1.3 .1 Demonstrate respect for own and other's customs and culture. It cannot be separated that at the intermediate level, students have gone through understanding and using the use of everyday language.

5.2 Opportunities and Challenges of Using Augmented Reality (AR)

In this study, Javanese cultural assets can be packaged in an easy-to-use AR application via mobile phones. The phone's camera will serve as a medium to identify virtual objects which will later appear on the device. Mobile augmented reality is one of the fastest-growing research areas in the augmented reality area (Azuma et al., 2011). This is because the emergence and widespread use of smartphones are able to provide a strong platform to support augmented reality on mobile platforms. In this case, the object being shot has high sensitivity and reality to the appearance of the 3D image. However, this research was only limited to objects of Javanese cultural assets which include houses, weapons, and traditional clothes. There is a need to digitize other cultural assets, such as rare and important cultural assets in museums.

According to Richards, CH site managers face major challenges in the cultural heritage industry and need to find new ways to attract and engage new visitors (Richards, 2007). The museum is a place to store and preserve various cultural objects. Museums will be in a better position to exploit their assets in a more effective way, as they will be in full control of the new technology. Museums need a cost-effective way to create virtual representations of their archives, as well as suitable for presentation to the public and cultural researchers. AR can provide an alternative means of navigation, interaction, and orientation in museums especially when museums do not have the necessary space and resources to exhibit their entire collections. Historical objects that were never even shown to the public will be made available to a wide audience through this application. Augmented Reality (AR) being one of the most

promising and cutting-edge technologies in modern times, its development and implementation in CH may be an opportunity to increase competitiveness (Attila & Edit, 2012; Jung & Han, 2014).

AR can be used and can change the experience of users or visitors to the CH site. Augmented reality is that it enables a fundamentally more engaging user experience and enriches content, which means that users will have great potential to explore and discover new information within objects using this technology. According to Haugstvedt & Krogstie, perceived enjoyment and perceived usefulness are important determinants of intention to use augmented reality applications with historical information and images (Haugstvedt & Krogstie, 2012). Users should be able to interact with digital content naturally and get additional information from the object being excavated. Furthermore, the system must provide a solution that allows the comparison and identification of artifacts, in different historical periods, that are found in a particular archaeological site.

The use of AR for Cultural Heritage can include further stakeholders, such as archaeologists and historians so that needs and desires in a reality are more objective and stronger. In addition, involving archaeologists and historians will strengthen the creation of value, substance, benefits, and user perspectives. Therefore, in the next 5-10 years, the value creation by AR on the CH site and updating the value creation framework is so important to ensure its credibility in the future.

AR development and implementation is an opportunity to increase competitiveness. Apart from being a material for preserving cultural assets, one of the most promising aspects of AR is that it can be used for highly interactive visual forms and game-based learning. This is appropriate to be conveyed to Indonesian Language Learners for Foreign Speakers (BIPA). In addition to introducing Indonesian culture, it can also be used as learning material (Zamahsari et al., 2021). Learners are provided with new tools that allow them to enhance the existing environment by supplementing it with expanded knowledge. Learning activities can follow different pedagogical approaches. Flow theory has been introduced in a game-based learning approach that addresses the problem of focus in learning activities and examines the problem of immersion (Chen, 2007; Csikszentmihalyi & Csikzentmihaly, 1990; Pilke, 2004).

AR offers new learning opportunities; it also poses new challenges for educators. Lee describes various technological, pedagogical, learning issues related to the application of AR in education (Lee, 2012). Bower, Howe, McCredie, Robinson, and Grover revealed that the use of Augmented Reality in education can be useful for developing their higher-order thinking skills (Bower et al., 2014). In addition, the approach produces a level of independent thinking, creativity, and critical analysis. Thus, Augmented Reality as a new learning technology has interesting potential in studying various collaborative and innovative learning and teaching problems.

6. Conclusion

Based on the description, it can be concluded that the development of Java Culture products with Augmented Reality (AR) technology is proven to be able to imitate object images (clothing, houses, and traditional weapons). The target image can display 3D objects (AR) easily and has a relatively high sensitivity. The development of this application can be utilized or implied by learning Indonesian for Foreign Speakers (BIPA). Apart from being a material for learning Indonesian vocabulary, this application can also be used to introduce Indonesian culture to BIPA students. This is in line with the objectives of BIPA learning, which is to introduce and gain wider recognition both at home and abroad regional and international level related to the Indonesian language and culture. This application can be implied in BIPA learning with intermediate to advanced levels or in level 3 to level 7.

This research only reached the stage of product development and implications for BIPA learning. For this reason, further researchers can develop it by conducting expert validation tests, both Augmented Reality technology experts and linguists or BIPA learning experts. This is to see the feasibility of the application in terms of technology and the language content in it. Further researchers can also conduct trials of using the product to see the level of success or effectiveness in learning and conduct dissemination.

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