Exploring the Potentials of Augmented Reality Poster for Civic Education in Indonesia

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Abstract. Traditional posters have long been utilized in civic education; however, they have struggled to capture the attention of digital natives. This study introduces an innovative solution by proposing an Augmented Reality (AR) Poster application to augment traditional posters. The research conducted an experimental study with university-level students who had no prior experience with Augmented Reality technology. The control group relied on traditional posters viewed with the naked eye, while the experimental group had access to additional video content displayed above the posters through the AR Poster application. Data analysis revealed that the experimental group demonstrated superior learning outcomes compared to the control group. Additionally, the experimental group exhibited a positive attitude towards the AR Poster application, perceiving it as user-friendly and beneficial for their learning. As a result, this study underscores the value of integrating video augmentation into traditional posters and recommends the inclusion of AR Poster development in the curriculum of the civic education department.

Keywords: Augmented Reality · Civic Education · Poster Education

1 Introduction

Current academic students are digital natives that fluently operate digital devices. They are incompatible with traditional learning methods and media [1]. Researchers are competing to develop learning media with advanced technology. Unfortunately, this is not the case in civic education. The number of civic education media is lean. Most of the learning media was developed for science, technology, engineering, and math (STEM) education. Furthermore, teachers of civic education lack the ability to develop learning media application. In the class, they usually use presentation media and display videos they get from the internet.

This situation reduces digital natives' interest in learning civic education. This generation shows a decline in altruistic activities and lacks respect for social values [2]. They are overconfident and have a high level of narcissism [3]. Negative consequences that occur are reduced empathy, attention to others, and involvement in community life. Thus, it is necessary to find a technology that suits the need of the digital native and can be adopted by civic education teachers.

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1.1 Civic Education in Indonesia

Civic education is a key to better digital citizenship. Unfortunately, the implementation of technology in civic education is left behind other learning subjects. It is primarily limited by teachers' competencies in using information and communication technology (ICT) [4]. They are not ready to adopt technology in their classes. This is because they have difficulty attending ICT training due to lack of opportunity, geographical challenges, time, and cost problems [5]. Indeed, the central government has established the Center for Multimedia Education and Culture Development (BPMPK) and the regional governments have established the Educational Information and Communication Technology Centers (BTIKP) to support ICT implementation in learning. Apart from providing ICT training for teachers, these centers also develop various kinds of learning media. Unfortunately, civic education is clearly beyond their priority. The number of learning media that they have developed for civic education can be counted on the fingers.

Admittedly, Indonesia is still lagging in ICT compared to neighboring countries such as Singapore and Malaysia [6]. The school facilities and infrastructure are not evenly distributed. There are countless schools that do not yet have LCD projectors in the classroom. Therefore, the technological skills of digital native students in Indonesia are debatable. Two primary reasons for digital natives' skill diversity are historical differences in access to technology [7] and educational background [8]. For example, in most K-12 schools, students are not allowed to bring mobile phones because of misuse and economic inequality issues. Many civic teachers give students homework to look for topics on the internet. Then students summarize and print it to be discussed in class. Therefore, students are barely using technology to learn at school.

In contrast, at the university level, over 95% of students have personal digital devices such as laptops and smartphones [9]. As a teacher-to-be, students in the civic education department are expected to be agents of change at school and have better ICT competencies than in-service teachers. However, they have never been taught yet the implementation of the latest technology such as augmented reality and virtual reality in teaching and learning. Thus, their competency and perception of such technologies needs to be assessed.

1.2 Augmented Reality Poster

The digital natives live in digital age and favor faster learning, less step by step, more in parallel, with more random access [10]. They do not have reading resilience and are not accustomed to complete references and books suggested by lecturers [11]. They are used to receiving short information (texts and videos) on social media and messaging applications. As an illustration, some platforms limit the duration of videos that users can share: InstaStory 15 s, WhatsApp status 30 s, and Tik-Tok 60 s.

Traditional learning media that contains short messages are inspirational posters. Inspirational posters can be easily found on school and campus walls. The initial purpose of posting posters as wall decorations is for habituation. Aristotelians believe that character can be developed through habituation [12]. Just as the purpose of repeatedly showing advertisements on TV, the message received repeatedly can attract viewers to think or act in accordance with the contents of the message. Inspirational posters

have been shown to increase involvement and reduce disruptive behavior of students in learning, influencing student learning and achievement [13]. However, the poster has no interaction with students and provides only visual messages.

The traditional poster can be enhanced by using Augmented Reality (AR) technology. The traditional poster can be enriched with digital multimedia information, such as audio, video, animation, and 3D objects. Additional media offers opportunities to view learning material from different perspectives, which are prerequisites for a deeper understanding of the essence of concepts and theories. Furthermore, AR technology overcomes the disadvantages of printed material by providing students interaction with objects from the real and virtual worlds [14]. Each interaction can cause different responses, which are new sources of information and knowledge. Thus, AR has potential to reinvent education that better meets the needs of 21st-century students [15].

AR applications are proven to increase learning motivation [16] and learning outcomes [17]. The AR application provides real-time measurements during direct experiments [18]. Therefore, AR applications are often developed for learning STEM (Science, Technology, Engineering, and Mathematics). AR applications can also be used in informal learning [19] and vocational learning [20]. AR applications make users more aware of the surrounding environment. The AR application encourages students to understand that their everyday environment is a potential context for more authentic learning [21]. In civic education in China, AR-based technology has been proved to promote better self-learning strategies and improve positive academic emotions, such as reducing anxiety and boredom [22]. Currently, AR technology compatibility has been widely supported by mobile devices. Thus, it can be easily integrated into almost every civic educational course.

Unfortunately, the research used an AR application that augmented animated 3D objects to the real world. This learning intervention requires a high level of interactivity. Students who are early adopters of the technology might find trouble in the learning activities. Furthermore, the development of the 3D object is burdensome for civic education teachers who lack computer skills. Because of the high level of complexity, 3D design development requires advanced software and hardware. The time-consuming development adds up to the difficulty for active teachers to produce AR application that augments 3D objects.

As an alternative, in this study, videos were augmented to traditional posters using AR Poster application. With this application, students can watch learning videos above the posters. These posters can be called Interactive Prints that refer to printed material that is combined with digital content viewed through a computer or mobile device. Some types of printed materials that can be combined with digital technology are Cards, Books, Notebooks, and Documents [23]. Its users interact differently with page designs and different pedagogical strategies [24]. For example, when combined with AR, cards are used as physical tokens that allow access and management of digital resources, whereas books have separate content values from digital content. Integration of AR with Posters can combine both card and book functions. Because students are used to running video player applications, they don't need additional training to use AR Poster.

1.3 Technology Acceptance Model

Digital natives are tech savvy and information literate. They can understand a new application's user interface and user experience (UI and UX) with a brief in application tutorial. However, their perception of a new application should be assessed to improve accessibility, acceptability, and adoption. Technology Acceptance Model (TAM) was developed by Davis in 1989. TAM was developed based on understanding why people accept or reject computers to get better prediction, explanation, and increase user acceptance [25].

TAM starts with the perception of technology usefulness (Perceived Usefulness) and ease of use (Perceived Ease of Use). These two perceptions were used to predict someone's behavior to use a product or not use it (Attitude Toward Using) which then has an impact on the behavioral tendency to continue applying a technology (Behavioral Intention to Use). This can be seen from the Actual Use (Actual System Use) which is measured by the amount of accumulated time spent interacting with technology and how often it uses the technology [26].

1.4 Problem of Research

Education and new technologies always go hand in hand and inform each other's developments. However, this does not apply to civic education. Until now, civic education has received little attention from learning media developers. Civic education became less and less popular for digital natives, resulting in a downfall in civic knowledge and skill. Thus, innovation of civic education media is getting more important. As such, three research questions are addressed below.

1. How is the design of Augmented Reality Poster that can be developed by civic education teachers who lack programming skills?
2. Is there any different learning performance between learners who use AR Poster and those who use traditional posters?
3. What are the learners' perceptions of AR Poster for civic education?

1.5 Research Focus

This study focused on enhancing traditional posters for civic education to meet the needs of digital natives. The intervention should be able to be adopted by civic education teachers who lack programming skills. An augmented reality (AR) Poster application was developed to show videos when students scan available posters. The study was aimed to explore the effect and to see students' perception of this learning intervention.

2 Method

2.1 General Background of Research

This study was experimental research to determine the relationship of the learning intervention with learning outcomes. The intervention was an Augmented Reality (AR) Poster application as a media to improve learning from traditional educational posters. The

posters can be found on the wall of the civic education department building which has three floors. So, the learners should go up and down stairs to see all posters. The AR Poster application was installed to the experimental group's smartphone. With this application, the experimental group can watch additional learning material (videos) by scanning the posters.

2.2 Sample of Research

This study participants were students in the politics and citizenship department, Semarang State University, Indonesia. Of several classes, two classes with 67 students were taken randomly. The first class, as a control group (n = 36), learned by using traditional posters. The second class, as an experimental group (n = 31), learned by using the Augmented Reality Poster.

Participants were the digital native generation born in 21st century. They owned a personal mobile device to use Augmented Reality Poster application. Therefore, researchers did not provide an additional device to support the learning activity. However, participants did not have the opportunity to use AR technology for learning before the experiment. Thus, their lecturer provided a brief guide on how to install and use the AR Poster application.

2.3 Instrument and Procedures

The instruments in this study consisted of learning media, learning assessment rubrics, and technology acceptance model (TAM) questionnaires. The learning media used were 8 printed posters and an AR Poster application that augmented 8 videos above the posters. The media were designed to adjust digital native characteristics and regarded that the subjects of this study did not have experience using AR technology. Posters and videos contained learning material about 8 conservational values promoted by Semarang State University, such as Inspirational Values, Humanist Values, Caring Values, Innovative Values, Sportive Values, Creative Values, Honesty Values, and Fairness Values.

The learning assessment rubric was used to evaluate whether students article showed the following points: (1) tells the story on the poster; (2) explains relevancy to own life; (3) describe the influential conservational values. Article scoring was conducted by two assessors.

The TAM questionnaire used in this study covered four aspects: ease of use, usefulness, attitude toward using, and behavioral intention to use. A total of 12 questions were in the questionnaire, and a 5-point Likert scale were used for all questions, with scale items ranging from 1 (strongly disagree) to 5 (strongly agree). A comment column was added to the TAM questionnaire for participants to write their ideas, thoughts, or experiences about the AR Poster. Questionnaires were made online to enable participants flexibly submit their answers.

Both experimental and control groups were given 2 weeks to study in the inquiry learning model, where students collected information from eight posters spread in the department building. Both groups learned from the same posters. The difference was that the control group saw the poster with a bare eye, while the experimental group saw the poster through the Augmented Reality (AR) Poster application. With this application,

students received videos as additional learning material. Both groups then wrote articles based on the information they obtained. These articles were used as an assessment of learning outcomes.

2.4 Data Analysis

The learning outcomes were analyzed using an independent T-test. Independent T-test is a comparative test to determine whether there is a significant difference in the mean between 2 independent groups with interval/ratio data scale. The two independent groups referred to two unpaired groups, meaning that the data sources come from different subjects. In this study, the T-test was used to determine the significance of differences between the mean of the experimental group and the control group scores. Then, Cohen's effect size was used to find out how much influence the intervention has on learning outcomes. The greater the value of Cohen's d, the greater the difference between the control group and the experimental group.

3 Result

3.1 Augmented Reality Poster

Augmented Reality (AR) has graduated as mature technology. Many AR-based applications have been developed to improve learning in formal, informal, and vocational institutions. In this study, an AR-based application was integrated with printed posters to improve civic education. The AR Poster application was developed with Unity 3D and Vuforia.

Detection of images in Augmented Reality did not see what the poster looks like but only saw the features in the poster. According to documentation on the Vuforia website, the feature is an acute angle image detected by the system. The more features detected, the better the augmentation rating. The Augmentation Rating determines how well an image can be detected and tracked using the Vuforia machine. The Augmentation Rating ranges from 0 to 5. The zero rating indicates that the target cannot be tracked at all by the AR system, while the 5-star rating indicates that the image can be easily tracked by the AR system. All posters in this study have a detection rating of 5 so that student smartphones can detect posters without any problems.

The AR Poster application was developed with a design that prioritizes ease of use due to the users not being familiar with AR technology. When the user opens the application, it will open directly to the main interface (AR camera). Thus, users simply point the application to the poster to get the explanatory video. The appeared video was automatically played.

A total of 8 videos were provided inside AR Poster. The videos were made in a small resolution (480 pixels) due to some students having a small amount of free space on their smartphones. A video with this resolution was clear enough to be seen on a smartphone. Students saw the video attached to the poster in public space, standing on their feet. Therefore, the videos were short, 1–3 min. The total size of the AR poster application was 100MB, including the video inside. This application was not made online or streaming because a low internet connection could cause several problems.

3.2 Learning Achievement

Learning outcomes in this study were generated from the assessment of participants' articles. The assessment was carried out by two people to reduce the subjectivity of the assessment. The average score of learning outcomes for the experimental and control groups were 87.77 (SD = 1.64) and 83.77 (SD = 1.83) respectively. The difference in learning outcomes was analyzed by an independent T-test. Table 1 shows a significant difference between the learning outcomes of the two groups, t (66) = 9.30 and p = 0,000. This shows that learning by using the AR poster-based significantly resulted in higher learning achievement than learning by using a traditional poster.

Table 1. Independent T-Test of Learning Achievement.

Variable	Group	N	Mean	SD	T
Learning Achievement	Experimental Group	31	87.77	1.64	9.30*
	Control Group	36	83.77	1.83	

* $p < 0.001$

Table 2. AR Poster Acceptance.

Variables	Items	Score
Perceived Ease of Use (E)	I feel that AR poster is easy to learn about its use	3,55
	I feel that AR poster is easy to master about its use	3,66
	I feel that AR poster is flexible in interaction	3,24
	I feel that AR poster is easy to use for learning	3,48
	Average	3,48
Perceived Usefulness (U)	I feel that AR poster improves my understanding.	3,17
	I feel that AR poster improves my performance of tasks	3,17
	I feel that AR poster makes it easier to learn	3,14
	Average	3,16
Attitude Toward Using (A)	Learning by using AR Poster is a good idea	3,48
	Learning by using AR Poster is a wise idea	3,38
	I feel positive about the AR poster	3,62
	Average	3,49
Behavioral Intention to Use (BI)	I want to open the AR poster when I see an educational poster	3,03
	I want to be a loyal user of AR Poster	2,66
	Average	2,84

Furthermore, Cohen's d was used to determine the effect size of the comparison between the two averages. Based on Cohen's effect analysis, learning with AR Poster displayed a large effect size with $d = 1.51$ ($d > 0.80$).

3.3 Technology Acceptance

The experimental group accepted the new technology, the AR poster, quite well. This was indicated by the results of the Technology Acceptance Model (TAM) 5-point scale questionnaire. They feel the ease of use (3.48) and usefulness (3.16) of the application. So, they have the attitude toward using (3.49) and the behavioral intention to use (2.84).

Variable ease of use (E) shows the level of usefulness that can be described as the capacity of a system to provide a condition for its users to perform tasks safely, effectively, and efficiently while enjoying the experience. Students rated relatively high for ease of use, such as flexibility in interaction (3.24), followed by the ease to use for learning (3.48), easy to learn about its use (3.55), and easy to master its use (3.66).

Variable Usefulness (U) shows the quality of having utility and especially practical value or application. Students felt that AR Poster increases understanding (3.17), improve performance on assignments (3.17), and make it easier to learn (3.14). These results were consistent with those presented in the learning outcomes, which indicate that the experimental group achieved higher scores than the control group.

Variable Attitude Toward Using (A) refers to user judgments about the desire to use certain information system applications. For students, the use of AR Poster was a good idea (3.48) and a wise idea (3.38). They also felt positive about it (3,62).

Variable Behavioral Intention to Use (BI) is defined as the extent to which a person has formulated a conscious plan to do or not perform certain behaviors in the future. When viewing an educational poster, students wanted to use the AR poster (3.03). However, they were a little hesitant to become loyal users of poster AR (2.66).

4 Discussion

This study began by developing an AR Poster application that integrated Augmented Reality technology with civic education printed posters. This application can be reproduced by teachers of civic education that lack programming skill. This study not only proved the potential of AR in improving learning outcomes but also the ease of use for the inexperienced digital native.

4.1 Learning Achievement Improvement

From the experimental results, it was evidenced that using AR Poster helped to improve civic education for digital native learners. With AR, the experimental group obtained videos as an additional learning resource when scanning posters. The video provided more detailed information about the poster. Video provided information through dual channels, namely visual and auditory. Based on Edgar Dale's Pyramid of Learning theory, students can capture more information by seeing and hearing (from video) rather than just reading (from posters) [27]. The AR Poster presented videos that were emulative,

incentive, and drill. Emulative means showing how to do an action or skill or showing a pattern of behavior. Incentive means being active in developing character, attitude, morals, and emotional responses. And drill means showing a series of actions to be copied by the viewer. These types of videos can provide a change in attitude for the better [28].

Learning by using multimedia may require extra cognitive effort. Mental effort refers to whether students must exert more cognitive work to understand the learning materials. In other words, a heavy cognitive load will hamper learning performance. Learning by using AR was proven to require low mental effort, even less than using conventional multimedia such as websites [16, 17]. When scanning posters, students are immediately provided with videos that suit their needs. Therefore, AR is a suitable technology for pairing with multimedia and can improve learning outcomes.

4.2 AR Poster Acceptance

Learning by using AR technology was a new experience for the participants of this study. Besides its usefulness, the ease of use of AR technology in learning became an important topic of learning. This research began by developing AR Poster application as the learning media. Students used this application to get additional video while scanning available posters on campus. All the posters received perfect ratings in their detection capabilities. So technologically, all posters were easy to detect.

The posters were printed using thick paper. This was done to ensure that the poster did not bend, curl, or wrinkle. In addition, it was ensured that the results of the print were not too glossy. Some light sources, such as lights, windows, or the sun, could make shiny reflections that cover most of the original texture of the prints. In such cases, it could create detection problems when using AR. Then, posters were posted in places that are often passed by students. Poster installation was carried out regarding the following: (1) flat wall surface, not rough or bumpy; (2) there was enough space to see the poster, about 1–2 m; (3) there was enough light so that the poster could be seen easily; (4) posters were installed without bending or rolling. These were done to ensure user convenience and comfort. Then, the Poster AR application was developed using a Vuforia engine. Vuforia was recommended because of its ability to detect printed objects [29]. This was confirmed in this study by zero negative responses from students in terms of detection. Thus, students highly rated AR Poster as Easy to Use (E).

The statistical analysis result showed outstanding learning performance of the experimental group. This was in line with students' perceived Usefulness (U) of AR Poster. They stated that AR Poster made learning easier and helped their understanding. Moreover, they stated that the learning process was interesting and flexible as an alternative method for civic education. This meant that students have a positive attitude toward using (A) AR Poster.

However, the learning process using AR Poster was done outside the classroom and the class hours. Students were given only two weeks to study from 8 posters around the campus. This short research period forced students to walk and look for the poster. As a result, some students felt uncomfortable and compared learning by using the AR poster with learning by using the campus website. They felt that watching videos by streaming through a website was easier than scanning a poster. A student suggested that posters should be made digitally and can be scanned from inside a laptop without having to print. In short, students felt that learning by using AR required more physical effort than using a website. One student suggested that the video can still be seen and run when the poster exits the AR camera. That way, he/she could see the video while walking or sitting somewhere. This could maintain a work-leisure balance, where the native digital generation values leisure [2, 30]. This is why their behavioral intention to use (BI) AR Poster was medium.

4.3 Implementation in Civic Education

AR Poster was a learning media that can be developed by teachers of civic education. Firstly, AR Poster development required almost no cost. AR Poster was developed using Unity and Vuforia which provide a free version. In addition, Augmented Reality requires no additional devices such as head-mounted devices for Virtual Reality. Vuforia, as an augmented reality software development kit (SDK), has high compatibility with a wide range of mobile phone types. So that students can use their devices to use AR Poster.

Secondly, AR Poster development required less time. The regular educational poster has many features to be detected by the AR system. So that teachers do not need to design a new poster. They can use available posters at school as their image target. Besides, AR Poster utilized videos rather than 3D objects to be shown above posters. Finding a video related to civic education on the internet is much easier than a 3D object.

Lastly, AR Poster could be developed by a teacher with no programming skill. AR Poster was developed without typing a single code. There were many tutorials on how to develop AR applications using Unity and Vuforia on the internet. Therefore, AR Poster has a high potential to be applied in civic education at school.

5 Conclusion

This study promoted the development of Augmented Reality (AR) Poster for civic education. This application not only gave a positive impact on students' achievement, but also gained a positive perception by students. AR Poster was relatively easy and fast to reproduce, even for civic education teachers who lack programming skills.

This study suggested heads of civic education department to provide AR technology development training for their lecturers and college students. Thus, this learning intervention can be implemented in a wide area.

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