

Smart Maps Indonesia Based on Augmented Reality as Digital Learning Resources of Social Studies

DOI: 10.15804/tner.2022.67.1.13

Abstract

This research develops AR in the form of Smart Indonesia Maps, which display information about natural features, geography, flora and fauna, culture, and social life on Indonesian islands in real-time. The objective of this research was to develop an AR-based Smart Indonesia Maps model as a digital learning resource in social studies learning. Embracing a Research and Development model has completed the preliminary field-testing stage of all ten stages of research. Limited trials were undertaken at state/private junior high schools in Bandung City, Bandung Regency, and West Bandung Regency, West Java Province, Indonesia, with the students and teachers as the research subjects. The data collection techniques included observation, interviews, document studies, focus group discussions, and attitude scale questionnaires. The results demonstrate that: Smart Indonesia Maps consist of main material objects by revealing the culture of the five major islands in Indonesia. The production of the model constituted three stages, namely pre-production, production, and post-production. The model was quite effective in fostering student critical thinking and creativity.

Keywords: *digital learning resources, Smart Indonesia Maps, social studies.*

Introduction

Advances in technology and information in today's era of the fourth industrial revolution allow for a transformation that combines the physical, digital and biological worlds through technologies media such as 3D animation, artificial intelligence (AI), Internet of Things (IoT), augmented and virtual reality, and next-generation robotics (Schwertner, 2017). Likewise, society 5.0 is nothing but human-centred, so artificial intelligence is tailored to foster 21st-century skills. It will have a positive impact on learning quality in the classroom. Learning should be supported by technology and digitalisation that will result in innovative, value-laden learning and touch real-world problems (Shapley et al., 2011; Saidin et al., 2015; Komalasari & Saripudin, 2017).

Among the crucial components of social studies learning during the COVID-19 pandemic, time is an ICT-based learning resource in line with the 21st-century learning competency and the characteristics of digital natives. Digital natives here are the Google or millennial generation. These terms are used to highlight the significance and importance of the new technologies in the lives of young people (Gibbons, 2007; Helsper & Eynon, 2010). One of them is learning resources based on Augmented reality (AR) that is emerging with the potential to be applied in education by providing an efficient method to represent models that require visuals to give users a sense of the real world when interacting with virtual objects (Singhal et al., 2012; Azuma, 1997). In the present research, digital social studies learning resources in the form of Smart Indonesia Maps supported by augmented reality were developed.

In real-time, the knowledge contained in this AR-based learning resource is an insight into natural features, geography, flora and fauna, culture, and social life on an Indonesian island using markerless techniques and virtual buttons. Several studies have shown that student learning outcomes improve after using digital learning sources so that students gain digital literacy skills, which are expected to help them make responsible decisions and actions (Wastiau et al., 2013; Hoskins & Crick, 2010).

Research Problem

Based on the background is the development of AR-based Smart Indonesia Maps in social studies learning to improve student digital literacy. The problem of research is specifically formulated as follows:

1. What is the conceptual model of AR-based Smart Indonesia Maps?
2. How is the model developed?
3. How are trial results on students using the model?

Research Methodology

General Background of Research

A development was utilised in this research to improve the research quality, in this case, the quality of their learning. The research sought to develop and validate a model to discover new knowledge through 'basic research' or to answer specific questions on practical problems through 'applied research', which are used to improve educational development practices (Borg & Gall, 2003).

Sample of Research

The limited trials were conducted at state/private junior high schools in Bandung City and Bandung and West Bandung Regencies, West Java Province, Indonesia. The research subjects were students and social studies teachers. The sample was selected purposively involving 510 students. The sample distribution and research locations such as SMPN 5 Bandung, SMPN 12 Bandung, SMPN 15 Bandung, SMPN 1 Lembang, SMPN 1 Soreang, and SMP Laboratorium Percontohan.

Instrument and Procedures

The data collection techniques were observation, interviews, document studies, and focus group discussions and instruments for assessing digital learning resources. Of the ten steps Borg and Gall (2003) have posited, this research adopted up to the preliminary field-testing stage, the specifics of which can be delineated as follows: (1) *Data and Information collection*; (2) *Planning*; (3) *Developing the Preliminary form of the Product*; and (4) *Preliminary Field Testing*.

Data Analysis

An interactive analysis model consisting of data collection, data reduction, data display and conclusion/verification was adopted to analyse the data (Fraenkel & Wallen, 2006). Expert validation involved experts in educational technology, social studies education, and IT experts specialising in Augmented Reality (AR).

Research Results

The conceptual model of AR-based Smart Indonesia Maps in social studies learning

Smart Indonesia Maps were made physically into a poster depicting a map of Indonesia integrated into a real-time system of natural, geographical features, flora and fauna, culture, and social life on Indonesian islands using markerless techniques and virtual buttons through an android-based system and visualisation in the form of Augmented Reality (AR).

In terms of the contents, several major geographical areas were identified to serve as the key material objects representative of the cultures of the five major islands in Indonesia, including Papua represented by West Papua, Kalimantan by West Kalimantan, Sumatra by Sumatra West, Sulawesi by South Sulawesi, and Java by West Java. For each region, the cultural elements such as geographical location, language, ethnicity, religion, traditional clothes, traditional songs, and special foods were identified. The following is an overview of the product display.

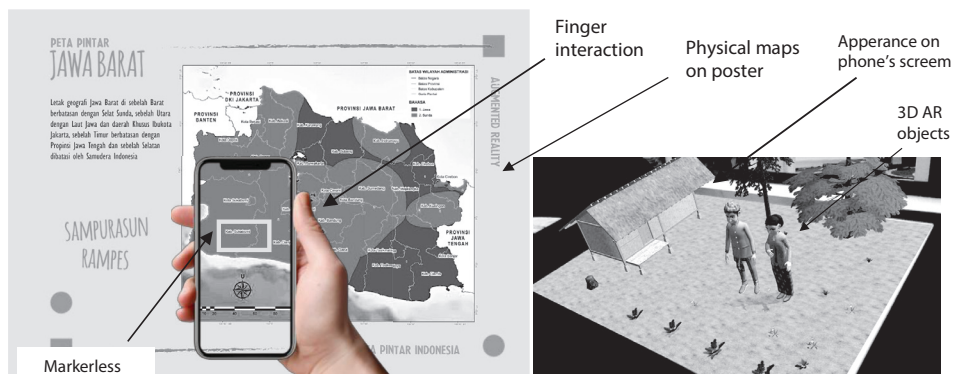


Figure 1. The display of the AR-based learning resources

Smart Indonesia Maps were engineered using a widely used software library to design AR applications and support markerless techniques. The markerless technique is very distinct from the fiduciary marker. AR is used to track objects in the real world without a special marker. To perform object tracking, the markerless AR system relies on natural-feature-tracking. AR markerless performs tracking with pre-existing objects, which are then used as target images to be detected to display virtual objects. Interaction on Smart Indonesia Maps is made possible through

virtual buttons previously defined by the developer on the target image, which will then be recognised by the camera for tracking. 3D objects will appear on the poster page along with the information. The information will then be displayed as an Augmented scene that can be viewed on the smartphone screen.

The production of the model

This production stage began with creating contents, backgrounds, image assets, video animations and visual effects, models and software that supports the use of AR.

- 1) At the beginning of production, the material contents for five provincial regions were identified, which would later be delivered by the voice actors. The background design was made to meet the panel layer requirements. This background asset was designed using pen tools with organic shapes with some parts coloured using a graded grey and some parts using only lines.
- 2) To meet the needs of information media, assets of several shapes and images in line with the ideas were made. The data assets were in the form of an eBook with a pdf file type so that the plugin feature in Illustrator, namely *import all to jpg*, was employed to export all files in the form of a single image.
- 3) At this stage, animated contents were created by processing static contents in an application and moving the static contents with other applications. It is crucial for a splash screen logo and panoramic image editing.



Figure 2. Basic models from South Sulawesi

- 4) The models were created, especially traditional houses per province, and women and men who wear traditional clothes per province. The modelling used an integrated application to create three-dimensional objects.
- 5) The next asset requirement is the creation of character models for each representative province (West Java, West Kalimantan, South Sulawesi, West Sumatra, West Papua). Below is one of the basic models from South Sulawesi.

The trial results on students using the model

The trial results were conducted in 6 (six) schools with 510 students. The model was tried out in junior high school social studies subjects with the subject matter adapted to the basic competencies. The test results can be presented as follows.

Table 2. The Trial Results on Students Using Model

No	Assessed components	Assessed aspects	Validation results (N=)			
			Excel- lent (%)	Good (%)	Fair (%)	Poor (%)
A.	Learning design	The model is easy to understand	25.9	66.7	7.4	0
		The model is easy to use	18.5	70.4	11.1	0
		The appearance of the model is attractive	59.3	37	3.7	0
Mean scores of Component A			34.6	58	7,4	0
B.	Quality of the application	The animated images in the model are presented clearly	37	48.1	14.8	0
		The AR function presented in Indonesia's Smart Map runs well	48.1	44.4	7.4	0
		The audio presented in the animated display sounds good	25.9	59.3	14.8	0
		The application can be installed on android devices properly	33.3	59.3	7.4	0
		The physical map for the marker is visible	25.9	55.6	18.5	0
		The marker function on AR works well	33.3	55.6	11.1	0

No	Assessed components	Assessed aspects	Validation results (N=)			
			Excel- lent (%)	Good (%)	Fair (%)	Poor (%)
Mean scores of Component B			33.9	53.7	12.4	0
C.	Effectiveness and interactivity of the application	The app effectively improves critical thinking and creativity	37	48.1	14.8	0
		The material in the app is in line with social studies learning materials	37	51.9	11.1	0
		The app allows for student interactivity	29.6	51.9	14.8	3.7
Mean scores of Component C			34.5	50.6	13.7	1.2
Total mean scores			34.33	54.11	11.16	0.4

The test table shows that most of the components of learning design, application quality, application effectiveness and interactivity were considered good. In learning design, what needs to be improved is the relative ease of applying the Smart Indonesia Map in social studies learning. In the aspect of application quality, the animated images in the app are not quite clear. In terms of the effectiveness and interactivity of the application, the teacher's activity with students does not go quite well. Corrections were made according to the needs and assessments of the users. It makes it possible to assist and support the social studies learning process to run well. The AR-based Smart Indonesia Maps development was deemed quite effective in fostering critical thinking and creativity and building 21st-century skills.

Discussion

The Augmented Reality-based Smart Indonesia Maps were developed as the product combines objects or virtual objects into the user's real environment and then projects them in real-time (Saidin, et al., 2015; Azzuma, 1997; Madden, 2011). The key characteristics of AR, according to Azuma (2001), can be summarised as follows: 1) integrating the real and virtual world in a real environment (blended learning); 2) real-time interactive; 3) 3D environment; and 4) applicable to all senses, including touch and hearing. The screen is used to indirectly view the mixed (virtual and real) world (Ivanova et al., 2014). The advantage of Augmented Reality is to allow macro or micro visualisation of objects that cannot be seen

with the naked eye and can help students better understand subjects (Cerqueira & Kirner, 2012).

AR can display information in real-time so that it is widely used in education, health, military, tourism, architecture, art, advertising, and many more (Villagoomez, 2010). The AR-based Smart Indonesia Maps, as digital learning resources especially in social studies learning, become a vehicle for providing authentic and up-to-date information to students to support textbooks which should be: a) accurate; b) relevant; c) self-sufficient; d) consistent; e) actual; and f) the structure of science (Komalasari & Saripudin, 2017). In addition, this type of learning resource can be useful for students because it can foster learning, develop critical thinking, hone students' ability to connect different concepts and bridge the gap between students' theoretical and practical knowledge (Yeo, 2008; Palmer, 2007; Bera & Liu, 2006).

Research has shown the importance of the role and interaction between students in a physical-digital learning environment because such an environment offers a way of representing ideas. This study supports distance learning with staying mental health amidst the COVID-19 pandemic (Komalasari & Rahmat, 2019; Komalasari et al., 2021). This research has also indicated how children creatively discover and use alternatives to their digital resources. This creativity is equivalent to the way students use the modes presented by digital learning resources (Kress, 2003). Creativity is one of the digital literacy abilities. It means the students' ability to understand information and knowledge digitally to master content (Rich, 2010). Digital literacy is defined as the ability to understand the information in various forms from sources accessed via computer and the ability to communicate with an evolving community to discuss problems, gather information, and seek help (Gilster, 1997; Saripudin et al., 2021).

Recent studies have adapted the use of digital learning resources, which creates an interactive learning environment and transforms passive learners into fully engaged active learners (Neumann et al., 2011; Geer & Sweeney, 2012; Dufresne et al., 1996). Furthermore, learning that involves digitisation can potentially enhance student insight as a form of literacy (Tomi & Rambli, 2013). This line of inquiry is worthy of attention in our endeavours of upgrading student literacy in navigating their social world through the use of digital media (Moje, 2002a; 2002b; Alvermann, 1998). These characteristics must be integrated with social studies learning to improve students' digital literacy.

The development of individual digital competence is contingent on the level of digital use and the ability to transform individuals into digital literacy. These levels involved are: 1) digital competence, covering individual general skills to special

skills such as critical and analytical skills (Martin & Grudziecki, 2006; Martin, 2008); 2) digital use, where users take advantage of relevant digital competences and elements specific to a profession, education, and social (Martin, 2008), and 3) digital transformation, enabling innovation and creativity, and stimulating significant change at the individual or organisational level in professional contexts. However, this final level of transformation is not a stage for becoming digital literate because one's digital literacy level depends on the right level of digital use.

Conclusions

The Smart Indonesia Maps were created in the form of posters of Indonesian maps, integrated into a real-time system of natural features, geography, flora and fauna, culture, and social life of Indonesian islands using markerless and virtual button techniques. Through an Android-based system, visualisation was presented in the form of Augmented Reality (AR). In the content identification, the main culture of the five big islands in Indonesia was uncovered, including Papua represented by West Papua, Kalimantan by West Kalimantan, Sumatra by West Sumatra, Sulawesi by South Sulawesi, and Java by West Java. The cultural elements such as geographical location, language, ethnicity, religion, traditional clothes, traditional songs, and special foods were then revealed. The production of the application was done through three stages, namely pre-production, production, and post-production. As a digital learning resource product, the Smart Indonesia Maps effectively fostered critical thinking and creativity and building 21st-century skills.

Acknowledgements

The research is funded through a grant from the Ministry of Research and Technology of Indonesia under the scheme of *Penelitian Dasar* (Fundamental Research Grant Scheme). The authors would like to express sincere appreciation for all the support provided.

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