Development of Augmented Reality to Preserve Ari Darma Reliefs and Tech Cultural Heritage Sites

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Abstract. Local history is a part of history that cannot be separated from learning in an educational unit environment. Ari Darma is one form of local wisdom depicted through reliefs on Jago Candi. When integrating Ari Darma reliefs in the learning process, teachers must realise this so that students can see directly what the reliefs look like. This can utilise augmented reality technology that contains the reliefs of Jago Candi. This article aims to describe the potential of Ari Darma reliefs as local history material in history learning using augmented reality technology. The method used in this research is 4D which consists of Define, Design, Develop, and Disseminate. The results show that Ari Darma reliefs have the potential to be included in the process of learning local history in schools through an independent curriculum. In the teaching process, technology integration is needed to present real situations to students when learning. This media development can be used in all learning situations, even though it is not in the classroom. However, the application requires assistance from the teacher to interpret each panel of the Ari Darma relief.

Keywords: Ari Darma Reliefs, Augmented Reality, Local History, Cultural Heritage, Historical Learning

1   Introduction

Local history is an inseparable part of national historiography. Local history provides an overview of national events from various perspectives. The aspect of locality in history is highly exalted in local history. According to Taufik Abdullah [1], local history is the history of a place, a locality, whose boundaries of events are determined by the author. Local history is often associated with myths that develop in the surrounding environment as a form of local wisdom values [2]–[4].

Teachers obtain local history materials through textbooks, journals, and events in the region [5], [6]. The existence of diverse local history materials provides its interest in learning [7]–[9]. This happens because students can gain new insights by studying the history of their area. The values of local history that are full of local wisdom positively influence students, especially in terms of preserving cultural heritage, which in this article is Jago Temple [10], [11]. The existence of innovative media will create a sense of belonging and a sense of wanting to preserve the cultural heritage.

In the independent curriculum, local history has the potential to develop and be taught to students in schools. This is stated in the description of history learning

outcomes and student and teacher package books, which state that teachers are free to develop material not in the package book (Badan Standar, Kurikulum, dan Asesmen Pendidikan, 2022). This material can be in the form of local history, which in this article is the Ari Darma relief on Jago Temple. Ari Darma material must be taught to students, especially in Greater Malang, to provide insight into their area's unique history and local wisdom.

The temple and all its physical elements are a form of culture that also contributes to the formation of local history. Students can deepen their understanding of Indonesia's cultural identity and the traditions that have shaped the country by studying candi architecture, art and historical significance. Studying these candi sites can spark discussions about religious practices, architectural techniques and the preservation of historic sites, providing valuable insights into Indonesia's past and present.

The candi and all its physical elements represent tangible culture. However, there are also critical cultural values within it that are considered intangible culture [13]. For example, in the case of reliefs in candis, there are visible cultural elements such as the shape, size, accompanying decorations, and invisible elements. These invisible elements include the accuracy of the scene with the original story (both in storytelling and textual form), the knowledge of carving techniques, carving style, and the message or meaning contained within the story.

The Jago Candi is a piece of cultural heritage that belongs to the Singhasari Kingdom, located in the Tumpang District of Malang Regency, about 15 km east of Malang City centre. It is known for its unique stepped design and is adorned with various relief sculptures, including Tantri Kamandaka, Parthayajna, Kunjarakarna, and Ari Darma (Angling Darma). The name "Jago" comes from the book Nagarakrtagama pupu 41:4, and the candi is home to a statue of Amoghapasa in the tantric form of Awaloketeswara and his followers in Tantrayana Buddhism [14], [15].

The Jago Candi is an archaeological heritage from the Singhasari kingdom that combines Hinduism and Buddhism. Despite "Sugata" being the same as "Buddha," Hindu reliefs indicate that this candi can be categorized as Siwa-Buddhist, reflecting the religion adopted by the Singhasari-Majapahit kings [16]. The function of the Jago Candi is to honour King Wisnuwarddhana as Buddha and Weleri as Shiva [17].

The Jago Candi is a marvel, not just for its historical significance but also for its diverse collection of reliefs. It is a rare gem in the world of candi architecture, boasting a rich assortment of reliefs that tell various stories. Most candis are known for one or two types of reliefs, but the Jago Candi stands out with its rich variety. The reliefs include the unique Ari Darma, or Angling Darma, depicting the story of King Malwapati's ability to communicate with animals. This particular relief is a treasure unique to the Jago Candi, not found in any other candi. While other candis often feature reliefs portraying animal stories such as Tantri Kamandaka or Jataka Awadana, the Ari Darma, or Angling Darma, is a well-known folktale.

Ari Darma, also known as Angling Darma, is a significant local wisdom that has been immortalised in songs and traditional arts. Despite variations in its portrayal across different mediums such as reliefs, songs, and performances, the story remains a cherished part of the local culture. The uniqueness of Ari Darma as a panji story, exclusive to Java, underscores the creative storytelling prowess of the Indonesian people, evident in the intricate carvings on the candi.

Based on the results of the needs analysis of students distributed through questionnaires by researchers in Malang Raya, it was found that students were interested and wanted to study Ari Darma reliefs. According to the students, the relief has never been discussed in learning and is not in the textbook. Therefore, the uniqueness of this relief can be used as a learning medium for students, especially in the Malang Raya area, when studying the history of Indonesia during the Hindu-Buddhist period. This makes it easier for students to learn the distinctive form of Ari Darma reliefs in Jago Temple. This relief can be presented in the classroom with augmented reality technology, but still with the assistance of history teachers. In addition, this learning media will make it easier for students to learn the history of the Singhasari Kingdom by looking directly at its cultural heritage without having to come to the place directly. This article will explain integrating augmented reality learning media with Ari Darma relief material in the learning process.

2   Method

The methodology used in this research is research and development. There are various models in the research and development methodology. The model used is the 4-D development model. The 4-D (Four D) development paradigm is a model for making learning devices. The authors of this model are S. Thiagarajan, Dorothy S. Semmel, and Melvyn I. Semmel [18]. The 4D development paradigm consists of four main stages: Define, Design, Develop, and Disseminate. The selection of this method and model is based on its objective to produce a product in an augmented reality media format.

In the defining stage, researchers identified problems starting from the needs of students who wanted Android-based learning media and the learning outcomes of the Hindu Buddhist Kingdom in the independent curriculum. Where in the independent curriculum, teachers are allowed to develop other materials as long as they remain within the scope of the curriculum. Next is the design, where at this stage, the researcher designs material in the form of Ari Darma reliefs to be used as learning media and in augmented reality format. In addition, Ari Darma reliefs were chosen according to students' needs because several scenes need to be included in the application. Then, the researcher also designed the initial design/mock-up of the augmented reality application. This research has yet to carry out trials and dissemination due to limited time and will be carried out in further research.

3   RESULTS AND DISCUSSION

3.1. Candi Jago
Jago Candi is located in Jago Village, Tumpang District, Malang Regency. The distance is about 17 kilometres to the east of Malang city centre. The initial findings of Jago Candi were documented sequentially by Th. S. Raffles in 1817, R.H.T. Friederich in 1854, J.F.G. Brumund in 1855, J. Fergusson in 1876, P.J. Veth in 1878, and J.L.A. Brandes in 1904 [15]. The name Jajaghu is mentioned in the literary works Pararaton and Nagarakertagama. Nagarakertagama records that the King of

Singhasari, Wisnuwardhana, who died in 1268 AD, was buried at Weleri Candi in Blitar as a Hindu and at Jajaghu Candi as a Buddhist [16], [19].

The Nāgarakṛtāgama and Pararaton are textual sources that mention this candi. According to these sources, it is known as the candi of King Wiṣṇuwardhana in the Nāgarakṛtāgama, Raṅga Wuni in the Pararaton, or Narārya Sminiṅ Rāt in the Mūla-Maluruṅ Inscription. The candi is named Jajaghu after the hamlet or location of the candi. Jajaghu is the historical name of the village of Jago. Fortunately, the name or toponymy of the village has not changed significantly, making it easily recognisable.

The main purpose of Jago Candi is to enshrine King Wiṣṇuwardhana as Buddha. However, he was also enshrined as Śiwa in Weleri. This information is obtained from the Nāgarakṛtāgama and Pararaton reports. Nāgarakṛtāgama mentions the sentence "Caka 1190 Bhatāra Vishnu mulih ing curalaya pjah dhinarma ta sire Waleri Ciwawimbha len Sugatawimbha" [20]. In addition, the Pararaton records the following statement: "Panjenenganira Cri Raṅga Wuni ratu taun 14, moktanira 1194, dhinarma sira ring Jajaghu" [21]. The original intention of this candi was to be a Buddhist candi, as Sugata was a Buddhist. However, based on the discovery of Hindu reliefs, this candi can be classified as an essentially Śiwa-Buddhist candi, which aligns with the religious beliefs of the Singhasari-Majapahit kings.

The architecture of Jago Candi is unique compared to other candis. Its uniqueness can be seen from the candi's base, which has three levels [19]. The first level has eight steps on each side, the second level has fourteen steps, and the last level has seven steps. The candi roof has collapsed, resulting in a narrow entrance or short corridor connecting to the centre area of the candi [19].
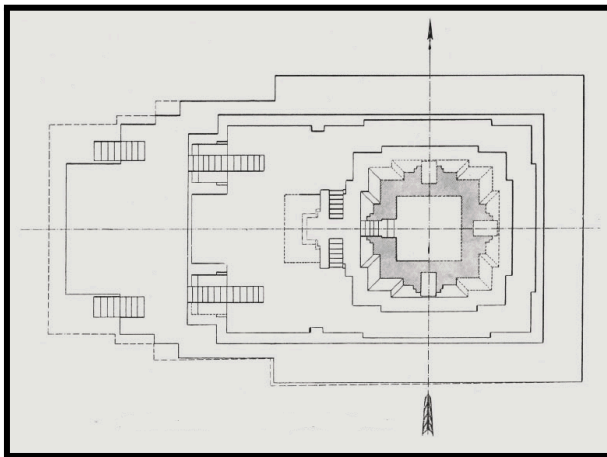

Figure 1. Groundplan of Candi Jago [22]

The candi is decorated with reliefs that cover almost the entire candi. The reliefs on the panels of the outer candi building depict many legends. The candi features an early narrative, Tantri Kamandaka, intricately carved on the foot of the candi terrace on the southeast and northeast sides. Ari Darma is located at the base of the first terrace candi on the northeast side, on the second floor. Kuñjarakarṇa is located on the

lower floors of the first terrace candi, particularly on the north and west sides. The fourth story, Parthayajna or Arjunawiwaha, is located on all sides of the foot of the second terrace candi. The last story is the Kresnayana, which is depicted on all sides of the candi structure [15], [16], [21]–[23]. Some reliefs have suffered from wear and tear due to weathering, while others have been lost due to the collapse of the walls.

The garbhagrha section of Candi Jago contains the main statue, Amoghapasa, along with other accompanying statues. Amoghapasa is said to be positioned in the centre of the room, facing west, by the orientation of the candi. The whereabouts of the companion statues of Hayagriwa, Bhrkuti, Syamatara, and Sudhanakumara, all of which are kept in the National Museum, are still unknown. According to Krom (1920), the placement of the four companion statues in the candi followed the visual representations found on the Amoghapasa bronze plates from the Kertanagara period and the Amoghapasa statues/inscriptions from the Adityawarman period. In particular, the statues of Shamatara and Sudhanakumara are aligned on the right, while Hayagriwa and Bhrkuti are aligned on the left. The outer niches of the body of Candi Jago are believed to be the repository of miniature Jina figures in a seated position, accompanied by their respective partners and facing a particular direction [25].

3.2. Ari Darma Relief

Ari drama is depicted as one of the sculptures adorning the walls (reliefs) of Candi Jago, alongside other reliefs, including Tantri Kamandaka, Pathayajna (Arjunawiwaha), and Kunjarakarna. Jajaghu, later known as Candi Jago, is a sacred candi dedicated to Wisnuwarddhana or Ranggawuni, sometimes referred to as Buddha in the Pararaton text [26]. Interestingly, this candi is also dedicated to Shiva in Weleri, as mentioned in the Nagarakrtagama text, particularly in Pupuh 41 [20]. This candi is located near Kidal Candi and is a tribute to Anusapati, the father of Wisnuwarddhana. The candi is in Jago Village, Tumpang Subdistrict, in Malang Regency. The architectural style of this candi from the Majapahit era is characterized by the design of stepped terraces and flat and upright batur that are decorated with various reliefs, depicting story and non-story elements. Unlike candis from the old classical period, this style has a rectangular plan instead of a square [27].

The Ari Darma relief is exclusively located at Candi Jago, making it distinctive. However, the narrative of Aridarma or Angling Dharma has been elaborated extensively in the form of kidung in many places. This eight-panel relief is intricately carved at the base of the northeastern front of the candi, after the Tanti Kamandaka relief. Although the text of the Angling Dharma story does not include a detailed description, the Aridarma relief scene in Candi Jago adequately describes the voyage of Aridarama. The narrative begins with a marker consisting of three circular shapes decorated with flowers, medallions, and a book, along with a vase of flowers forming a square pattern [16]. The relief depicts a male dragon with evil intentions towards a female dragon, symbolised by two interlocking dragon snakes (hinting at perversion). Aridarama succeeded in foiling the evil plan, and as a reward, the dragon king (father of the female dragon) bestowed upon him the power to communicate with animals.

Table 1. Scenes in Aridarma Relief

No	Relief	Image on Relief	Story Scenes

1		It opens with three circles of flowers, a medallion, a book and a vase of flowers arranged in a square pattern. There is also a depiction of a forest scene and a dog.	The story begins with Ari Darma travelling to the forest, represented by trees/plants and dogs.
2		Then a man is seen carrying a short sword and shield and two dragons wrapped around each other.	It tells the story of a male dragon seducing a female dragon, wanting to do something evil to the female dragon (*rudapaksa*), and Aridarma trying to save the female dragon.
3		The second depiction depicts a dragon in motion (dragons) and another in a sitting position with its head sticking up (dragon king).	In the story, the female dragon Aridarma saved is seen walking home to meet the Dragon King (her father) and telling him about Aridarma's kindness.
4		The following image shows the setting of the palace of Malwapati (Aridarma's kingdom), where a	This scene tells of the dragon king disguised as a Brahmin to meet Aridarma in his palace to thank him for saving his son

		turbaned rsi and a man are seen talking.	from evil deeds and disgrace. The disguise of the dragon king as a Brahmin is identified from the dragon king's use of the rsi surban.
5		This image shows the two people in the previous image walking into the building through a gate.	This scene shows the dragon king and Aridarama walking towards Malwapati's palace. As an expression of gratitude, the dragon king allowed Aridarma to speak with animals.
6		There are depictions of men and women meeting in Malwapati's palace.	Identified as the meeting of Aridarma and Istrina. This scene also tells the story of Aridarma telling his wife about his experiences during his travels, saving the female dragon, until he is visited by a Brahmin and given magic.

| 7 | | The following relief panel shows a picture of a man (Ari Darma), a woman (Ari Darma's wife), and several courtiers. | This picture tells the story of Aridarma's wife, who persuades Aridarma to show the magic that he has obtained from the Brahmana, or dragon king. Ari Darma does not want to tell his magic because he has promised the Brahmana. Therefore, the wife was angry and asked Ari Darma to prove his loyalty by plunging into the flames with her. The courtiers were called to prepare the flames and call the people to witness it. |

| 8 | | The last relief panel depicts the ritual of the flames. | This relief explains that Ari Darma's wife decided to end her life on a pile of wood. The king initially intended to go along but changed his mind after hearing the advice of a ram and an ewe who considered the act foolish. They remind him that there are many other women in the world.

The final scene features the pavilion where Anliii Darma is, a blazing fire, the tower from which the queen will jump, and two talking animals. |

3.3. Ari Darma Relief Augmented Reality Application

Augmented reality (AR) is a powerful tool that has become popular in history education. It provides an immersive and interactive experience that brings historical events to life. This technique places digital content, such as photographs, films, or 3D models, into a physical environment so students can directly experience historical events [28], [29]. Augmented reality (AR) can transform conventional classrooms into interactive learning spaces, allowing students to engage with historical landmarks and observe historical events as if they were physically present [30], [31]. AR can transform historical teaching and learning methods by connecting the past and present.

The potential of augmented reality (AR) to increase student participation in history classes is one of its main benefits. Augmented reality (AR) offers a multisensory and immersive learning environment that captures students' attention

and inspires them to engage with the material actively [32], [33]. Students can, for example, use augmented reality (AR) devices to explore virtual reconstructions of historical sites, such as interpreting Ari Darma reliefs in Candi Jago.

AR not only increases student engagement but also provides several other instructional advantages. Augmented reality (AR) can improve students' understanding and recall of material by offering interactive visual representations of historical subjects that are considered abstract [34], [35]. By viewing objects directly, students can use augmented reality (AR) to analyse cause-and-effect relationships, monitor changes over time, and hone critical thinking skills.

In applying augmented reality relief Ari Darma, teachers can make it a learning media on Hindu-Buddhist kingdoms' learning outcomes, especially the Singhasari Kingdom material. This learning media attempts to realise the 3-dimensional form of Ari Darma relief so that students and teachers do not need to come directly to Candi Jago to see and study the relief. Using this learning media requires assistance from the teacher because not all information on this media can be interpreted independently by students directly. The teacher can provide an introduction, teaching materials, and learning resources related to Ari Darma reliefs.

The following is the display of the Ari Darma relief augmented reality application. The first is the initial/home display when opening the application. On this display is an application called 'ARIMA', a play button that allows you to play Ari Darma relief augmented reality. Another feature is the menu containing material about Candi Jago and Ari Darma reliefs. In addition, an options button is an instruction for the user. Moreover, the out button is available for users if they want to exit the application.

Figure 2. Home Page View

The page on the menu, when clicked, the user will be delivered to the material feature, which consists of a map display of the position of the Candi Jago. The map contains material about Candi Jago, including its history and development. Finally, the Ari Darma relief material contains the story in the relief accompanied by illustrations.

Figure 3. Material Page

Figure 4. Material Page

Another feature is the play button, which, when clicked, gives the user the experience of seeing the Ari Darma relief in three dimensions. This feature makes it easier for teachers and students to learn the three-dimensional form of the studied material directly. In addition, this makes the classroom atmosphere more interactive because teachers and students can interact directly with relief objects.

Figure 5. Augmented Reality Features

Figure 6. Augmented Reality Features

4   CONCLUSION

This research aims to investigate and understand the significant impact of digital technology, namely Android-based applications, in preserving and interpreting Ari Darma reliefs at Jago Temple. The adoption of augmented reality is facilitated by its accessibility and comprehensiveness in various circles. The findings of this study prove that digital technology is a valuable instrument for teaching local history in the classroom. The app offers an interactive and engaging way to access knowledge about Ari Darma reliefs on Hindu-Buddhist Kingdom content. The app presents a new technique for understanding and appreciating local history learning in Malang Raya. In addition, the app enhances users' educational experience by offering local historical and artistic insights about Ari Darma reliefs and engaging them in an interactive learning process. The story of the Ari Darma relief is one of the materials rarely discussed in learning; therefore, researchers try to present it in local history teaching. So, with this media, especially for students throughout Malang Raya, they can get to know the local history and wisdom that exists in Jago Temple. This can also make students throughout Malang Raya more curious and preserve the cultural heritage of the Jago temple. It also becomes a link between the past and the present, allowing the following students to engage with meaningful and modern local history learning.

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