# UMM metaverse batik as a learning media to introduce nitik batik motifs in the Sonobudoyo Museum

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ARTICLE INFO

ABSTRACT

The exposure of Yogyakarta's Nitik Batik motifs is one of the important efforts to maintain and introduce Indonesia's cultural heritage to the younger generation. In this context, metaverse-based learning media is used as an innovative solution. This research discusses the implementation of metaverse-based learning media with an Extended Reality (XR) approach to introduce the Yogyakarta Nitik Batik motif. This research uses the Game Development Life Cycle (GDLC) development method to design a VR-based Batik museum virtual space, with black box testing and refinement testing to assess functionality and fun aspects. Involving 33 participants from visitors to the Sono Budoyo Batik exhibition in Yogyakarta, this study analyzed the data descriptive quantitative to develop recommendations for improving user experience and introducing Yogyakarta Nitik Batik culture through the metaverse. The test results showed that the virtual space of the Batik Museum passed the functional test without failure and had a feasibility rate of 86.1% in the category of "Excellent." These findings indicate that VR technology effectively introduces and preserves Batik culture, especially as an educational material in virtual media. This metaverse based learning media is anticipated to be an innovative step in introducing Yogyakarta's dotted Batik while offering a valuable immersive experience for users. Future research can be done by adding gamification to increase visitor involvement and optimizing multimedia aspects that have not been the main focus.

## INTRODUCTION

The cultural richness of Indonesia is highly diverse, spanning from music to ancient forms of written art. One enduring cultural facet that remains preserved is Batik (Ripai & Kunci, 2021). Batik stands as an iconic cultural symbol of Indonesia, acknowledged as a cultural heritage by UNESCO on October 2, 2009 (Wulansari et al., 2022). In Javanese, the term "Batik" originates from "mBatik" (to write) and "titik" (dot or point), signifying the act of drawing dots on cloth (Sari, 2018). Batik encompasses a wide array of patterns or motifs, traditionally drawn on fabric. These patterns are recurrently arranged to illustrate a fundamental motif throughout the fabric. Originating on the island of Java, Batik has expanded to various regions across the archipelago, resulting in the creation of diverse motifs corresponding to respective regional cultures. This diversity makes it challenging for people to distinguish between the various Batik motifs and their regional origins (Flaurensia et al.,

2016). The development of technology in the modern era has significantly influenced multiple aspects of life. One notable impact of technology is the digitization of education and culture. In the realm of education, it has been observed that the presence of online learning media or digital tools has a positive impact on learning motivation, academic achievement, and engagement in the learning process (Mandasari, 2020).

Furthermore, technology also plays a significant role in providing different explorative experiences towards culture. Batik encompasses various motifs in different regions across Indonesia. One of these is "Batik Nitik," originating from the Yogyakarta region. Modern technology has enabled us to comprehend and appreciate this cultural heritage in new ways. One such method involves the use of metaverse technology. The term "Metaverse" is a compound term consisting of the elements "Meta" and "universe," referring to a post-reality, perpetual universe that merges the physical world with the digital virtual world (Mystakidis, 2022). According to Zhang et al., (2022), the metaverse is defined as a technology that signifies the creation of a new virtual universe that surpasses the real world. The metaverse is a reality that enables user interaction and provides functionalities similar to real-life scenarios (Mystakidis, 2022), such as engaging in commercial activities, socializing, learning, teaching, and even virtual meetings like conferences. The metaverse can be accessed through various platforms, ranging from Desktop Web, Android, and iOS to VR Headsets.

In the context of technological innovation, Extended Reality (XR) has become a highly compelling concept. XR is a general term that encompasses all immersive technologies generated by computers. XR includes virtual reality (VR), augmented reality (AR), and mixed reality (MR) (Çöltekin et al., 2020; Rauschnabel et al., 2022). XR technology has significantly transformed our learning paradigms and interactions with culture. As a learning medium, XR enables society to explore worlds previously inaccessible through traditional methods (Sulistiani et al., 2023). With the aid of XR, entire communities can obtain in-depth and detailed visualizations of objects or environments being studied (Haris & Purbojo, 2024). Furthermore, the use of XR allows for more intimate interactions with the content contained within the XR environment itself. Additionally, the benefits of the metaverse can enhance the desire to learn, as the nature of augmented reality present in the metaverse can elevate students' imaginations with the real world directly (Pauji et al., 2022). Education today is not merely collaborating with technology but has become a potential source for developing education in the era of digitalization (Wijayanto et al., 2023). Presently, we are amid the fifth industrial revolution, characterized by a world of virtually limitless life or communication, supported by the internet, digital technology, computers, and other devices. The rapid advancement of technology is beyond human comprehension (Harianto, 2021).

With the potential of XR (Extended Reality) technology in both education and cultural appreciation and the difficulties in preserving cultural treasures such as the distinct Yogyakarta dot motif Batik, there exists an opportunity to fuse these components into metaverse-centered educational tools. However, as of now, there's a lack of research that explicitly combines XR technology with teaching the intricate patterns of Batik within the metaverse setting. Studies focusing on educating about Batik designs through metaverse learning tools are infrequent. Present research solely showcases a metaverse exhibition of Batik, primarily intending to market or enhance Batik sales following the COVID-19 pandemic (Purnawirawan et al., 2022). Hence, metaverse-based learning resources are evolving as an innovative approach, particularly in introducing the Yogyakarta dot motif Batik and delivering an immersive encounter for users.

This research aims to create a Batik museum virtual space that can be accepted by the public to preserve Batik culture as an Indonesian cultural heritage and focus on introducing the Yogyakarta-dotted Batik motifs. Alongside technological advancements in the modern era, the digitalization of education and culture has significantly provided positive impacts. This method is expected to enhance motivation for learning Batik, a cultural heritage owned by Indonesia, especially among the younger generation tasked with perpetuating this culture. Furthermore, this technology enables exploration and appreciation of cultural heritage, such as Batik, in new and immersive ways. Thus, this metaverse-based learning media is anticipated to serve as an innovative step in introducing Yogyakarta's dotted Batik while offering a valuable immersive experience for users.

**METHOD**

This research applied the development method as the main approach. The development model used is Blitz Game Studio's Game Development Life Cycle (GDLC), which consists of six stages: 1) Pitch, 2) Pre-production, 3) Main Production, 4) Testing, 5) Beta, and 6) Master. In the fourth stage, format details testing using the black box method was conducted, as well as refinement testing that focused on the fun and quality aspects of the virtual space that had been developed. The three main components that contribute to the fun experience in this media are expectations, engagement, and endurability, which are measured through playtesting using a Likert scale. This study involved visitors to the Sono Budoyo Batik exhibition in Yogyakarta, with participants randomly selected from visitors who were willing to try the metaverse application during the exhibition. A total of 33 participants, consisting of men and women aged 10 to 50 years, participated in this study. The data obtained was analyzed using a quantitative descriptive method based on the results of the participant questionnaire. The results of this analysis are used to formulate conclusions and recommendations related to the development of metaverse applications to introduce culture, especially Yogyakarta Batik Nitik motifs, with an emphasis on multimedia aspects and optimal user experience. The stages of this research can be seen in Figure 1.
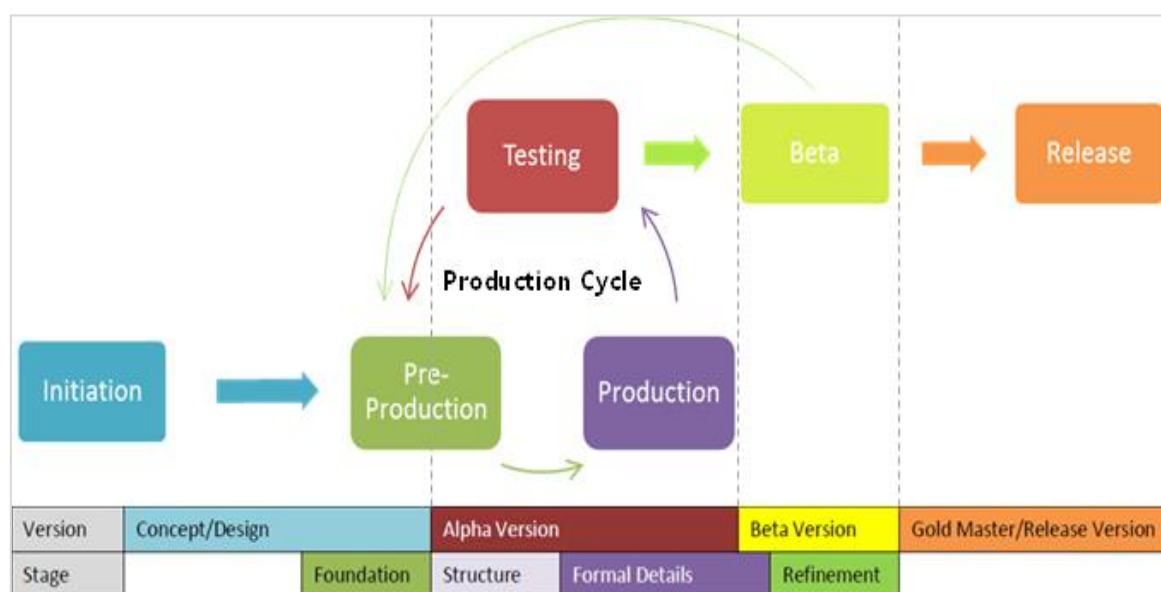


Figure 1. The Flowchart Development Process of Batik Metaverse

**RESULTS AND DISCUSSION**

**Results**

The conventional method of familiarizing oneself with Batik patterns, typically limited to museum visits, has now transformed into a repeatable experience through the virtual realm or metaverse. Sono Budoyo Museum stands out as one of the institutions showcasing a diverse array of Indonesian arts, notably Yogyakarta's Batik Nitik. Utilizing metaverse-based applications employing an Extended Reality approach, the exploration of Batik motifs serves as an educational tool, aiming to sustain Indonesia's cultural heritage. The educational tool developed to introduce Yogyakarta's Batik Nitik motifs in this study is a 3D simulation environment constructed using the Unity Game Engine. This virtual space is accessible across various platforms such as PCs, mobile devices, Virtual Reality Headsets, and other gadgets supporting Augmented Reality mode. Users can convene within this developed virtual space, echoing the concept of metaverse technology. This metaverse application is accessible via the spatial.io website under the name UMM Metaverse - Batik, leading to an interface resembling the depiction in Figure 2, and can be accessed at https://bit.ly/40W84Xb.
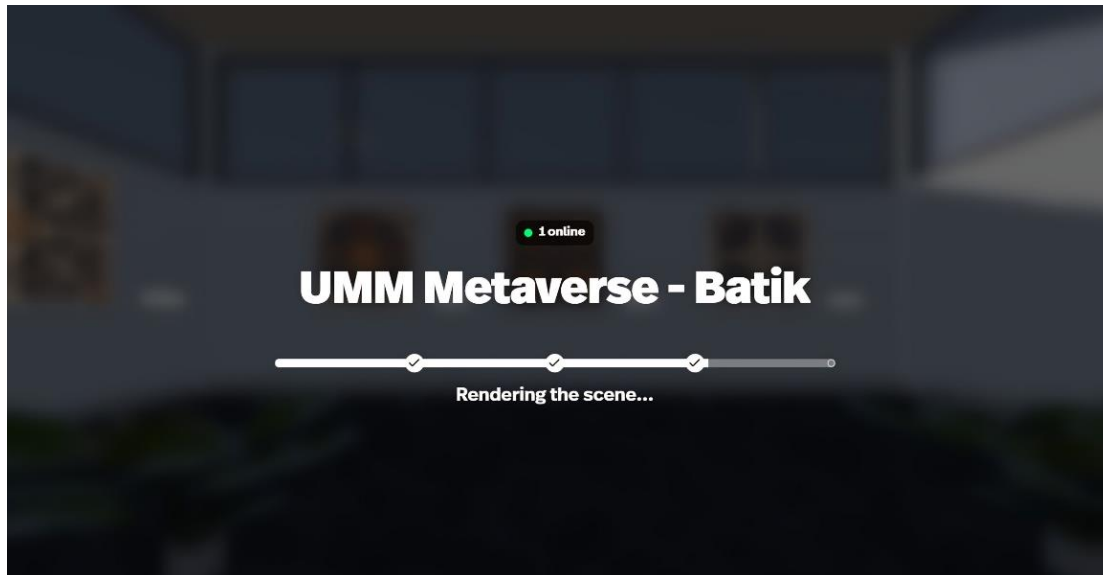
Figure 2. Thumbnail Screen

A compelling aspect of the metaverse is the ability for users to create virtual identities or avatars, representing themselves within this digital realm. The metaverse presents substantial potential across diverse domains, encompassing education, entertainment, business, and the cultural arts. For instance, it serves as an innovative platform for remote learning, including the exploration of Batik patterns.

Following the appearance on the page, there will be guidance for logging in and subsequently choosing an avatar. However, if accessed through a mobile device, users are obligated to first download the spatial application from the Play Store. Once the user has logged in, the interface resembling image 2 will become visible below. Figure 3 shows a sample of the Batik virtual space.



Figure 3. Sample of Batik Virtual Space

On that page, there is an audio feature of gamelan sounds to make the application more realistic as if one were in a museum exhibition. Additionally, there are instructions located in the bottom left corner in the form of a black box to guide users in navigating the application, such as walking towards the Batik exhibition or enlarging the layers to see the displayed Batik motifs. Furthermore, the names of the available Batik motifs are provided, as shown in Figure 4 below.
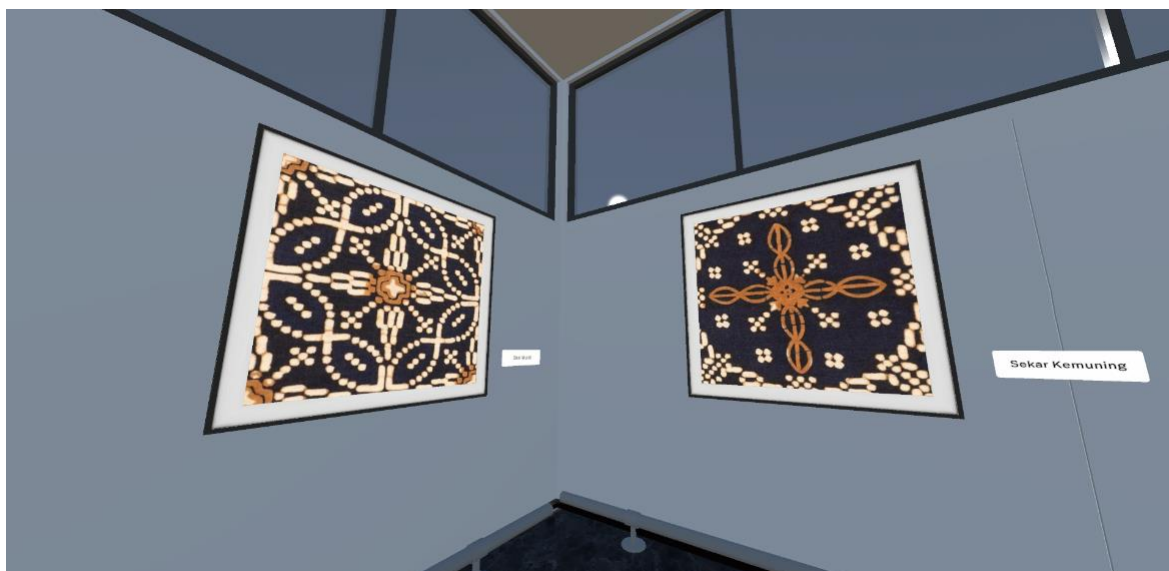
Figure 4. Batik Displays

Following the observation of Batik patterns through the application, participants were requested to complete a survey provided by the researcher. This study was conducted with 33 attendees of the exhibition, including 17 men and 16 women, spanning ages from 10 to 50 years. The research employed a 25-question survey to gather data after the participants' use of the Metaverse-based application with an extended reality approach focused on Batik Nitik Yogyakarta. The survey results will be classified into 5 distinct categories, ranging from very low to very high, as outlined in the accompanying figure.

Two types of testing were conducted, namely, alpha testing and beta testing. Alpha testing uses the black box method and refinement testing to test the success of functionality in virtual space. Alpha test participants involved three developers and one quality assurance person. Alpha testing covers the three main aspects of creating a fun experience in media, namely expectations, engagement, and endurability. The refinement testing process is done through playtesting, which aims to observe and document all feedback from testers, including any bugs, gaps, or failures found, as well as their responses regarding the fun aspects of the game.

The results of black box testing that has been carried out show that the functionality provided in the virtual space of the Batik Museum can function properly and by the input. After alpha testing is passed, the next stage is beta testing involving external parties, namely visitors to the metaverse booth stand at the Sonobudoyo Yogyakarta Batik Museum. Based on the results of the questionnaire sheets that have been distributed, a recapitulation is carried out to analyze the virtual space of the Batik Museum, which has been filled in by 33 respondents who are virtual space users. The following is a graph of the results of beta testing for each question based on the results of the calculations that have been carried out.
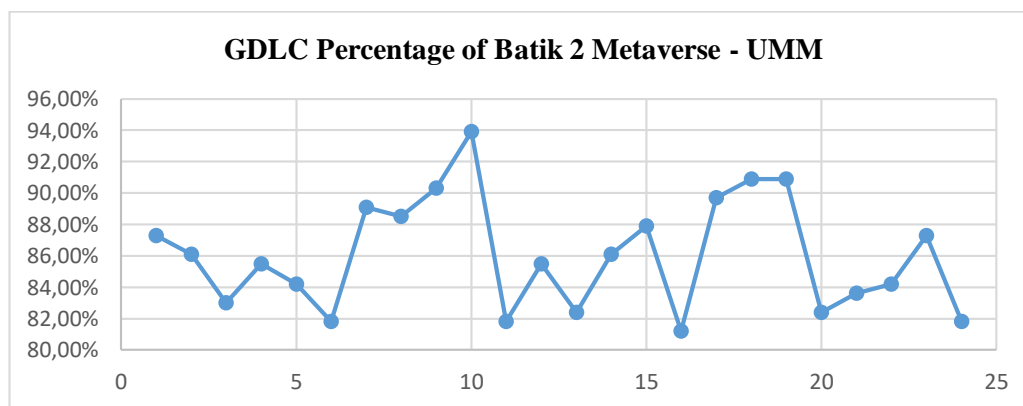


Figure 5. Percentage Chart of Batik 2 Metaverse – UMM

From the results of beta testing (see Figure 5), the Batik Museum virtual space obtained an average percentage of 86.1%. The highest percentage value of 93.9% for the tenth question assessment regarding the images available can give an attractive impression in the virtual space environment. The questionnaire results show that the text, images, audio, animation, and controller in the batik virtual space get a positive assessment from the respondents. The text is considered easy to understand and relevant, the images are considered high quality and give a real impression, the audio fits the atmosphere and enhances the experience, the animation strengthens the visualization and is not overwhelming, and the controller is easy to use and very responsive. Overall, these elements support comfortable and effective interaction in the virtual space, and the design of the batik museum virtual space using the GDLC method can make it easy to understand and can also increase public interest in batik culture.

Based on the survey analysis, individuals aged 49 experienced difficulties in understanding and reading the text in the application, whereas others found it clear and easy to read. This difference may be due to age-related vision issues or challenges in understanding English, as mentioned in the application's instructions. In terms of images, audio, and animations, most participants perceived them as clear and comprehensible. However, many users expressed dissatisfaction with the controller, likely due to unfamiliarity or difficulty in maneuvering avatars, particularly for first-time users. This indicates that there are still attendees at the exhibition who might not fully grasp the application's usage or for reasons not explored, like age constraints in adopting technology or other unidentified factors. Nevertheless, over 60% of the surveyed participants affirmed that the Metaverse-based media utilizing Extended Reality techniques is deemed effective, ranging from good to excellent, in introducing the Batik Nitik motif from Yogyakarta.

**Discussion**

As media becomes an essential human requirement, it evolves alongside the development of electronic platforms in the virtual realm (Hapidz et al., 2022). Education and learning in various activities cannot disregard technological advancements (Indrabayu et al., 2022). Instead, such progress can be leveraged as a positive tool, such as in familiarizing individuals with the Batik Nitik motif. Hence, all societal segments, whether voluntarily or not, must prepare for and engage in understanding these developments.

The era of education influenced by the Fourth Industrial Revolution has now utilized digital technology in the learning process known as the cyber system, where this system is capable of making the teaching and learning process happen without spatial or temporal limitations (Endarto & Martadi, 2022). Research conducted by Raharja et al. resulted in the recognition of the Yogyakarta Batik motifs using Backpropagation Artificial Neural Network technology to create learning media using various technologies to introduce Batik motifs to the public (Raharja & Widyatusti, 2022). Furthermore, research conducted by Sanjaya et al., introducing Batik motifs using the metaverse, serves not only as an educational tool but also as an opportunity to introduce Indonesian products and seek attention from many people, fostering numerous expectations within the metaverse. Moreover, the possibility of connecting many people globally in one location is also feasible (Sanjaya et al., 2022).

In the research conducted by Handayani, it was stated that the community lacks sufficient knowledge about the various types of Batik. Considering that the artistic creations of Indonesian Batik motifs need to be preserved and legally established for the learning of the nation's future generations (Handayani, 2023). The preservation of Batik is consistently confronted by issues related to the lack of knowledge within the community and the shortage of skilled human resources proficient in Batik-making (Suryaningsih et al., 2016). Therefore, the creation of educational media becomes a valuable development to introduce Batik motifs to the community, enabling them to expand and preserve the cultural heritage owned by Indonesia.

**CONCLUSION**

This research has designed a UMM Metaverse Batik using the Game Development Life Cycle (GDLC) method. The test results show that all functions in the virtual space of the Batik Museum

pass the functional test based on black box testing without any failures. In addition, the refinement test shows a feasibility level of 86.1%, which is categorized as "Very Good," so this virtual space can be considered feasible to use. The implications of these findings show that VR technology can be an effective medium in introducing and preserving the Batik culture to the wider community. Nevertheless, there are still some aspects that can be improved. The researcher recommends adding gamification elements so that visitors not only explore but also get challenges or quests to increase their engagement. In addition, this research focuses more on designing virtual spaces so that the multimedia aspect has not received optimal attention. Therefore, methods such as the Multimedia Development Life Cycle (MDLC) are recommended to improve the quality of media presentation. In general, based on the test results, the design of the Batik Museum virtual space using the GDLC method proved to be easy to understand and has the potential to increase public interest in Batik culture.

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