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Mahligai: An Immersive Video Game Approach to The Digital Preservation of Istana Melayu Melaka Architecture Among Malaysian Youth

Mahligai: Pendekatan Permainan Video Yang Menarik Kepada Pemeliharaan Digital Seni Bina Istana Melayu Melaka dalam Kalangan Belia Malaysia

Khairul Hakimin Alias[1], Mohd Firdaus Mohd Herrow[2*], Shahnazeem Sahminan[3], Muhammad Ashrie Ajari[4]

[1] Department of Information Technology, Centre for Diploma Studies, Universiti Tun Hussein Onn Malaysia
[2] Faculty of Art and Design, Universiti Teknologi MARA Selangor Branch, Puncak Alam Campus, Malaysia

***Corresponding author email:** firdausherrow@uitm.edu.my[2*]

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ABSTRAK - Istana Melayu Melaka represents a significant symbol of the Malay Sultanate's architectural heritage. However, challenges such as modernization and declining public awareness threaten its cultural relevance among younger generations. This study explores the use of immersive video game technology as a digital preservation strategy aimed at enhancing heritage engagement among Malaysian youth. A mixed-method approach was employed, combining a semi-structured interview with a heritage practitioner and a two-phase questionnaire administered to adolescents aged 13–17. The interview informed the exterior architectural reconstruction process, while pre- and post-gameplay questionnaires were used to evaluate perceived engagement and educational effectiveness among adolescent participants. Findings indicate that participants responded positively to the immersive visual environment, narrative structure, and gameplay progression. The majority reported increased awareness and interest in the architectural heritage of Istana Melayu Melaka following gameplay. The study suggests that immersive digital platforms can function not only as preservation tools but also as engaging educational mediums that bridge cultural heritage and contemporary youth audiences. The Mahligai project demonstrates the potential of interactive game-based environments in supporting architectural preservation initiatives through experiential learning approaches.

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INTRODUCTION

Istana Melayu Melaka, or the Malay Palace of Malacca, stands as a visual memory of the Sultanate period. Its form blends both Islamic influences with indigenous Malay crafts, which is illustrated through carved timbers and layered rooflines. However, this heritage does not stand free of threats. Development in the city, changing environments, and even public indifference create pressure. A report from the Malaysian Institute of Architects (PAM) notes that only careful conservation and proper communication will keep the palace from being pushed aside by modern structures (Isa et al., 2018). In response to these growing preservation challenges, alternative strategies beyond conventional conservation practices must be explored. While physical restoration remains important, digital technologies offer new pathways for sustaining architectural memory and cultural awareness among contemporary audiences.

Within the broader framework of digital preservation, the concept of immersion becomes particularly significant. Preservation is not merely about recording data, but about recreating experiences that allow users to engage meaningfully with reconstructed environments. Since digital materials are fragile, many scholars have advocated the need for firm strategies (Li et al., 2023). This subsequently makes the idea of immersion central. While some describe immersion as losing the sense of real time and slipping into full involvement with the task or world presented, others call it a state where one feels wrapped within an environment and receives a flow of experiences and signals. Both notions underline that immersion belongs to the individual (Pallasena et al., 2022).

Among various digital platforms, video games present a uniquely interactive medium that integrates visual immersion, narrative progression, and user agency. These characteristics make games particularly suitable for delivering architectural heritage content in an engaging format. For younger audiences (i.e., teenagers) between the ages of 13 to 17 years old, the delivery of history through interactive play often works better than text alone. This is supported by past research, which reported how games raise interest and sustain attention (Ramli et al., 2020). Therefore, the purpose of this study was to design a project named *Mahligai* using Unreal Engine and Autodesk Maya. It introduces the Malay Palace of Malacca through tasks such as collecting artifacts and unlocking information from markers and prompts. The structure is scoped to three stages that blend both visual design and play, aiming to make the palace's unique exterior forms clear to its players.

The broader goal was twofold: (1) To analyze the architectural characteristics of *Istana Melayu Melaka* through expert validation and digital reconstruction; and (2) To evaluate the perceived effectiveness of an immersive video game in enhancing youth engagement and awareness of architectural heritage.

LITERATURE REVIEW

The Malay Palace of Malacca was constructed during the height of the Malacca Sultanate between 1456 and 1477 under Sultan Mansur Shah. It served multiple roles, including as a gathering place for dignitaries, an administrative center, and a hub for spreading Islam. The Malay Palace Museum of Malacca replicates the grandeur of these historical structures based on descriptions from "*Sulalatus Salatin*" (Rodi & Musa, 2021). Notably, the museum's architecture is unique for its iron nail-free construction and seven-tiered roof, symbolizing hierarchy and social status in Malay culture. Despite these impressive features, research indicates that the replica falls short of capturing the full spirit and grandeur of the original palace. The replica, designed by the Melaka Painters Association with input from museum authorities and public feedback, was scaled down to fit the available construction space, reflecting compromises made during its creation (Suaib et al., 2020).

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Culture Heritage

Culture encompasses the ideas, customs, fine arts, and achievements that shape daily life norms, varying regionally due to factors such as geography, religious practices, and historical influences. It is expressed through language, religion, cuisine, social habits, music, and arts, ultimately influencing community lifestyles. The United Nations Educational, Scientific, and Cultural Organization (UNESCO) defines culture as the unique spiritual, material, intellectual, and emotional characteristics of a social group, encompassing art, literature, lifestyles, communal living, values, customs, and beliefs.

Meanwhile, heritage is represented by objects like the Malay Palace of Malacca and ancient manuscripts such as *Sulalatus Salatin*. It connects past, present, and future generations, thus preserving cultural identity and reflecting community beliefs and experiences. According to UNESCO, tangible cultural heritage includes artifacts, buildings, monuments, sites, writings, works of art, and objects of social significance that are physically experienced. These remnants embody cultural, historical, and aesthetic values, serving as evidence of past events. As human interaction influences the environment over time, the entire environment becomes part of this heritage. The Malay Palace of Malacca, which was once the administrative center of the Malacca Sultanate, exemplifies well-preserved cultural heritage.

Finally, architecture represents human-constructed physical spaces and events in both spatial and temporal contexts (Centofanti et al., 2019). Modern applications, such as Autodesk Maya, offer innovative methods for preserving and maintaining the history of structures like the Malay Palace of Malacca through 3D modeling. While historical texts provide evidence of the palace's existence, people often seek visual information. Digital modeling technologies have revolutionized architectural surveying and representation, enhanced the accuracy of information conveyance, and provided visual depictions of historical subjects (Sun, 2022). Thus, 3D digital visualizations effectively convey the existence and history of such structures.

Understanding cultural heritage conceptually provides the foundation for recognizing why digital preservation methods are necessary. As architectural heritage represents tangible cultural memory, the question becomes how such structures can be documented and communicated effectively in the digital era.

Digital Preservation in Malaysia

According to UNESCO, digital preservation involves safeguarding data, information, or assets to ensure their effective storage and future utilization. Malaysia has collaborated with UNESCO to preserve its cultural heritage, with several sites recognized as world heritage locations, including Malacca and George Town, the Kinabalu National Park, the Historic Cities of the Straits of Malacca, the Inscribed Stone of Terengganu, and the Langkawi UNESCO Global Geopark in Kedah. These locations are known for the diverse population of various ethnicities, cultures, and religions. However, Malaysia faces the risk of losing these cultural heritages due to factors like modernization, assimilation, and globalization. Modern technology has been increasingly used as a digital platform to facilitate accessing and collecting valuable information and cultural knowledge from different ethnic groups (Mohd Herrow & Azraai, 2023).

While digital preservation techniques such as 3D modeling and photogrammetry enhance documentation accuracy, they do not always guarantee public engagement. Therefore, integrating preservation within interactive platforms such as video games may address this limitation. Video games are widely enjoyed for leisure, whether played alone or with others. Their popularity has transformed the gaming industry beyond mere entertainment, influencing aspects like education and social relationships (Centofanti et al., 2019). Games designed to convey informative content, such as Kahoot! and Assassin's Creed Origins by Ubisoft, exemplify how video games can engage players in storytelling, foster healthy competition, and improve focus on various subjects. These games demonstrate the potential of interactive media to educate and entertain simultaneously.

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Visual immersion in video games refers to captivating players within the game world through factors like compelling graphics and engaging storyline that sustain their interest until the game's completion. The goal of any visualization system is to enhance the comprehension of visual information (Quwaider et al., 2019). The evolution of computer software and hardware has driven the emergence of 3D animation technology, profoundly impacting fields like film and television (Thöny et al., 2018). Utilizing tools such as Unreal Engine and Autodesk Maya facilitates the creation of visually striking 3D products and games that draw players into immersive experiences.

Malay Palace of Malacca

According to *Pustaka Melayu* (n.d.), the Malay Palace of Malacca was built during Sultan Mansur Shah's reign between 1456 and 1477. It stood as a central structure in the Malacca Sultanate and served as a meeting place for dignitaries, a center for administration, and a hub for spreading Islam. The Malay Palace Museum of Malacca was inspired by historical descriptions from *Sulalatus Salatin* and showcased the architectural splendors of the era. Notably, the palace was built without iron nails and featured a seven-tiered roof symbolizing hierarchy and social status, with higher tiers representing greater power and prestige. The original palace was destroyed by the Portuguese in 1511 during their conquest to control Malacca as a vital trading center. A replica of the palace, located at *Bukit Melaka*, was constructed by the Melaka Painters Association based on "Sejarah Melayu" descriptions. Although it was scaled down to fit the site, the replica aims to capture the original palace's grandeur (Suaib et al., 2020). Its design took into account feedback from museum authorities and public opinion collected during exhibitions, though some research has noted dissatisfaction with certain modifications. Nevertheless, the Malay Palace of Malacca remains a national treasure, representing the rich history and governance of the Malacca Sultanate, with its legacy preserved through manuscripts and the museum's efforts to safeguard the historical architecture.

To contextualize the *Mahligai* project within existing digital heritage initiatives, several related works were examined. These projects illustrate varying degrees of visualization accuracy and interactivity, highlighting both advancements and existing research gaps.

Related Past Research

Table 1: Previous Research, Descriptions, Advantages, and Disadvantages.

Product	Description	Advantage	Disadvantage
Empayar: The Malacca Chronicles (UniVRse Interactive Sdn. Bhd.)	Empayar: The Malacca Chronicles is a third-person 3D mobile action RPG with a linear narrative focusing on an alternate.	Focused on exploring the development of Kota Malacca via a 3D model. Still under construction now.	The 3D model produced has a low poly count. So far, the game focuses more on fighting elements to provide knowledge to the players.
Virtual Tour *Istana* Malacca (Gshock Active)	A channel for fans of Malaysian history, urban planning, skyscrapers, and architecture, especially Malay architecture.	The interest is translated through 3D imagery graphics in a relaxed and light way that entertains while instilling identity in the audience.	There is no interaction between players and the object around the 3D model.

continued

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Analyzing Digital Photogrammetry for Heritage Preservation (Robert Alan Kesack)	Analyzing Digital Photogrammetry for Heritage Preservation is an in-depth analysis of the technical variables impacting the photogrammetric processes in architectural conservation.	Effectively preserve the original form of cultural heritage.	There are no interactive elements that could potentially engage audiences with the work.
Interactive Motion Comic: The Fang King (Raja Bersiong) (Nor Farizah et al., 2018)	Promote local folklore and heritage to younger audiences in a fun and immersive play style through motion comic.	Players can control the flow of the story.	There is no other interaction that allows players to interact with the product besides the story.
VR Heritage: Chinese Cultural Heritage in The Digital Age (Jiawei Zhang and Lala Zuo)	The database was developed by Peking University to store and record hundreds of cultural heritage sites in China.	Produce highly accurate 3D images of historical sites that can be viewed in VR.	There are no interactive elements between players and objects in VR.

The current landscape of digital methods for cultural heritage preservation showcases a variety of approaches, each with its own strengths and limitations. Products like "Empayar: The Malacca Chronicles" and "Interactive Motion Comic: The Fang King" leverage engaging gameplay and narrative control to create immersive experiences, but they often focus more on entertainment and less on interactive elements with the cultural artifacts themselves. Meanwhile, "Virtual Tour *Istana* Malacca" and "VRHERITAGE: Chinese Cultural Heritage in the Digital Age" provide valuable 3D visualizations of historical sites, yet they fall short in offering interactive experiences that could enhance user engagement and learning.

Research such as "Analyzing Digital Photogrammetry for Heritage Preservation" emphasizes the importance of precise digital documentation for conservation but highlights a gap in interactive features that could further engage audiences.

In conclusion, while there is significant progress in using digital medium to preserve and present cultural heritage, there remains a noticeable gap in integrating interactive elements that would allow users to engage more deeply with the content. Future developments could benefit from combining high-quality visual representations with interactive features that facilitate a more immersive and educational experience.

RESEARCH METHODOLOGY

Research Design

This study adopted a mixed-method approach combining qualitative and quantitative data collection techniques. The qualitative component involved a semi-structured interview with a heritage practitioner to validate the architectural interpretation of *Istana Melayu Melaka*, while the quantitative component consisted of pre- and post-gameplay questionnaires administered to adolescent respondents. This design allowed the study to integrate expert validation with user-based evaluation in assessing the effectiveness of immersive digital preservation.

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The digital reconstruction developed in this study focused primarily on the exterior architectural features of *Istana Melayu Melaka*, including roof structures, façade detailing, and overall spatial configuration. This focus was guided by the availability and consistency of historical references, which provide more substantial documentation of exterior elements than interior layouts.

Semi-Structured Interview

The first stage of the study involved gathering reference materials and cross-checking historical descriptions with domain expertise. A semi-structured interview was conducted with Mr. Mohd Faizal bin Mamat @ Rahmat, a historian and practitioner of traditional architectural visualization. He was selected due to his long-standing involvement in reconstructing historical architecture, including 3D modeling work on Kota Melaka since 2005.

The interview aimed to clarify ambiguities in historical manuscripts such as *Sulalatus Salatin* and *Hikayat Hang Tuah*, particularly regarding architectural elements that lacked detailed descriptions. Observational visits to the Museum of the Malay Sultanate Palace in Melaka were also conducted to document spatial proportions, structural layouts, layered roof forms, and interior arrangements. The replica, measuring approximately 67.2 meters in length, 18.5 meters in height, and 12 meters in width, provided visual cues that supported digital modeling decisions.

Interview data were transcribed and thematically reviewed to extract architectural insights relevant to the development of the *Mahligai* game environment. This process ensured that the digital reconstruction was grounded in both textual references and professional interpretation rather than speculative design.

Questionnaire Survey

A two-phase questionnaire was administered to evaluate both baseline knowledge and post-gameplay experience. The first phase assessed respondents' prior knowledge of *Istana Melayu Melaka*, familiarity with digital games, and thematic preferences. The second phase was distributed after gameplay to measure user satisfaction, perceived visual immersion, narrative engagement, and gameplay progression.

The main target group consisted of adolescents aged between 13 and 17 years old. The selection of this age range was grounded in developmental theory and digital engagement patterns. Adolescents within this stage are situated in Piaget's formal operational stage, characterized by abstract reasoning and the ability to interpret symbolic representations (Piaget, 1972). These cognitive capacities are essential for engaging with reconstructed historical environments presented through immersive digital simulations. Furthermore, research in game-based learning indicates that secondary school students demonstrate strong engagement when educational content is delivered via interactive platforms (Ramli et al., 2020).

Instrument Design

The questionnaire consisted of structured closed-ended items designed to measure four key components: (1) prior knowledge of architectural heritage, (2) gaming preferences and engagement patterns, (3) visual and narrative satisfaction, and (4) perceived educational effectiveness. Pre-gameplay items focused on respondents' awareness of architectural features and symbolic elements of *Istana Melayu Melaka*, while post-gameplay items evaluated the immersive quality of the visual environment, gameplay mechanics, storyline progression, and difficulty balance.

Most items were presented using dichotomous (Yes/No) responses to ensure clarity and accessibility for adolescent participants. This format facilitated straightforward descriptive statistical analysis while maintaining respondent comprehension and response consistency.

The questionnaire items were structured to align with the study objectives, particularly in evaluating perceived learning impact, heritage awareness, and engagement levels following gameplay. This ensured that the instrument directly measured the effectiveness of the

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immersive digital environment in communicating architectural heritage content.

Sampling Technique and Representative

A purposive sampling technique was employed, as the study aimed to evaluate user experience within a specific demographic group rather than to produce statistically generalizable findings. Participants were selected based on predefined criteria, namely adolescents aged between 13 and 17 years old who were familiar with digital games and interactive media.

Respondents were recruited from an educational setting within the Pagoh Education Hub for accessibility and feasibility within the study timeframe. A total of 51 respondents completed the preliminary (pre-test) questionnaire to assess baseline knowledge and gaming familiarity. Upon completion of the *Mahligai* gameplay session, 33 respondents participated in the post-test evaluation, which functioned as a pilot assessment of the game's immersive quality and perceived educational effectiveness. The reduced number reflects participant availability during the post-gameplay session and does not affect the exploratory nature of the study.

Although the sample does not statistically represent the entire Malaysian youth population, the findings provide exploratory insights into how digitally active adolescents respond to immersive heritage-based video games. The results should therefore be interpreted as contextual rather than universally generalizable. Future research may consider larger and more diverse samples to enhance representativeness and external validity.

Data Analysis

Quantitative data obtained from the questionnaires were analyzed using descriptive statistical methods. Frequencies and percentages were calculated to identify response patterns across knowledge levels, gameplay satisfaction, and perceived immersion. The findings were presented using charts and graphical representations to facilitate comparative interpretation between pre- and post-gameplay responses.

Qualitative data from the semi-structured interview were reviewed and thematically summarized to extract architectural interpretations and reconstruction insights. The integration of both qualitative and quantitative findings enabled a more comprehensive evaluation of the *Mahligai* project as both a digital preservation tool and an immersive educational medium.

RESULTS

Results of Interview with Mr. Mohd Faizal bin Mamat @ Rahmat

The interview with Mr. Mohd Faizal provided extensive insights into the architecture of the Malay Malacca Palace Museum. He shared his expertise, spanning two decades in creating 3D models of the palace. According to Mr. Faizal, while the museum aims to depict the historical essence of the palace, its architectural authenticity remains a subject of interpretation. He primarily draws from historical manuscripts like *Sulalatus Salatin* and *Hikayat Hang Tuah*, acknowledging the variance in historians' interpretations of these texts. This nuanced understanding significantly influenced his approach to constructing the 3D model, highlighting the complexities of historical accuracy versus artistic interpretation.

Moreover, Mr. Faizal's contributions extend beyond mere visualization, impacting the development of the *Mahligai* game through his insights into storytelling and gameplay style. His emphasis on the palace's architecture underscores its role as a pivotal narrative element within the game. Overall, the interview underscored the challenges and creative decisions involved in faithfully representing historical architecture in both museum exhibitions and interactive media like the *Mahligai* game.

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Table 2: Question and Answer with Mr. Mohd Faizal

Question	Answer
1. Is the Malay Palace Museum of Malacca a true representation of the original architecture of the Malay Palace of Malacca during the Sultanate era?	● The replica is an imitation of what still exists. ● The Malay Palace Museum of Malacca is designed based on descriptions in the *Sulalatus Salatin*. ● This project depicts the Malay Palace of Malacca but does not claim complete accuracy. ● History cannot be perfectly visualized by people today.
2. Is the description of the Malay Palace of Malacca in the *Sulalatus Salatin* detailed?	● The description in *Sulalatus Salatin* is general and not very detailed. Examples of the mentioned features include a seven-layered palace roof with gold-painted carvings. ● Interdisciplinary research to combine several sources as references. Refer to studies on traditional Malaysian architecture.
3. Can the architecture of the Malay Palace Museum of Malacca be trusted if the depiction is not accurate?	● The Malay Palace Museum of Malacca was introduced by the late Abdul Rahim Nasir, a researcher of Malay history and traditional architecture. It won the design competition for the Malay Palace of Malacca, which was organized by JKR and the Government of Melaka. ● It was adapted for museum purposes and built in Melaka. This design concept is the main foundation.
4. How did Mr. Faizal obtain reference materials to produce the 3D model of the Malay Palace of Malacca?	● Studied the history of Melaka and stayed for 10 days. Met with PERZIM to ask about the history of Melaka. Read *Sulalatus Salatin* and *Hikayat Hang Tuah* for preparation.

As depicted in Table 2, Mr. Mohd Faizal's approach to recreating the Malay Palace of Malacca in a 3D model involves meticulous cross-research, integrating various studies to compensate for the general descriptions lacking specific details in the *Sulalatus Salatin* manuscript. He ensures fidelity by referencing traditional Malaysian architectural styles when interpreting features like the seven-tiered roof with gold-colored painted carvings. Emphasizing the significance of the Malay Palace Museum of Malacca's architectural concept, Mr. Faizal credits its design to Abdul Rahim Nasir, integrating his expertise in Malay history and Traditional Architecture.

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This design, originally chosen through collaboration with JKR and the Melaka Government, forms the foundation for depicting the palace accurately within their project. Mr. Faizal's preparation included ten days of on-site research in Melaka and consulting PERZIM representatives about Melaka's history and culture and was bolstered by prior readings of *Sulalatus Salatin* and *Hikayat Hang Tuah* to streamline discussions and enhance his project's authenticity. Beyond expert validation, it was equally important to assess how the reconstructed environment was perceived by its intended audience. The following section presents findings from the youth questionnaire survey.

Results of Youth Perspectives on the Malay Palace of Malacca and Video Game Themes

The questionnaire was designed to evaluate the understanding of 51 respondents aged 13 to 17 regarding the architecture of the Malay Sultanate Palace in Melaka. It was structured into sections covering personal details, gaming preferences, and knowledge about the palace.

Figure 1 shows the respondents' answers regarding aspects that make video games more interesting and themes that are suitable for use in video games. These answers were used to determine the theme and quality standards for the video game.

(a)

(b)

Figure 1: Feedback (a) and (b) Regarding the Audience Perspective on Video Games

The respondents believed that a video game is made interesting when it has high-quality graphics (79.5%), gameplay mechanics (76.5%), and an engaging and appealing storyline (64.7%). Their preference for video game themes included fantasy (62.7%), science fiction (21.6%), and Isekai (15.7%).

Meanwhile, Figure 2 illustrates the respondents' level of knowledge about the Malay Palace of Malacca and their sources of reference. These answers were used to convey information about the Malay Palace of Malacca in the form of a video game.

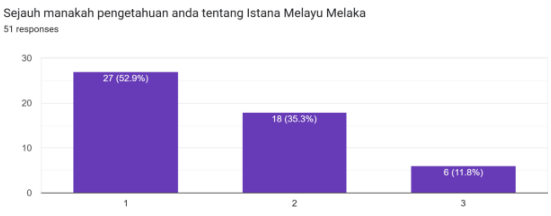

Figure 2: Feedback (a) and (b) Regarding the Audience's Knowledge about the Malay Palace of Malacca

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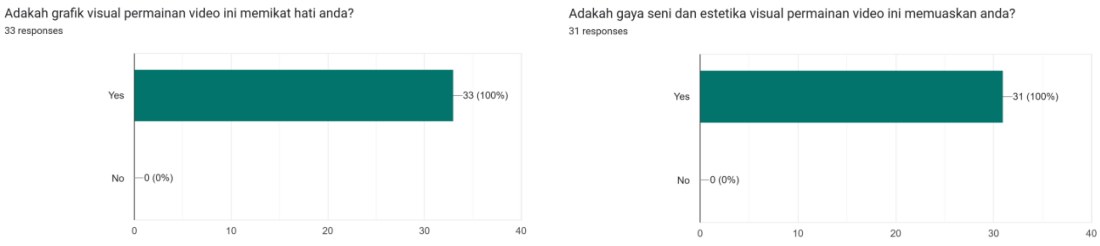
The respondents' knowledge about the Malay Palace of Malacca varied, with 52.9% having low or no knowledge, 35.3% having moderate knowledge, and 11.8% were knowledgeable. Their information sources included reading materials (74.5%), visits to the location (17.6%), and interactive games (7.8%). The data indicate the need for more effective methods to disseminate information about the Malay Palace of Malacca to reach a wider audience. Utilizing diverse channels, such as educational video games or virtual tours, could significantly enhance awareness and understanding, particularly among individuals who currently have limited knowledge about the palace.

Results of Gameplay Experience and Market Potential among Teenage Players.

Following the initial assessment of participants' background knowledge and preferences, a second survey was administered after gameplay to measure experiential and perceptual outcomes. The second questionnaire was administered via Google Forms to elicit feedback from 13 to 17-year-old respondents upon experiencing the *Mahligai* video game. It comprised 10 closed-ended questions, which required the respondents to respond with either yes or no. The survey evaluated aspects such as visual graphics appeal, ease of game controls, challenge progression, and the effectiveness of information delivery.

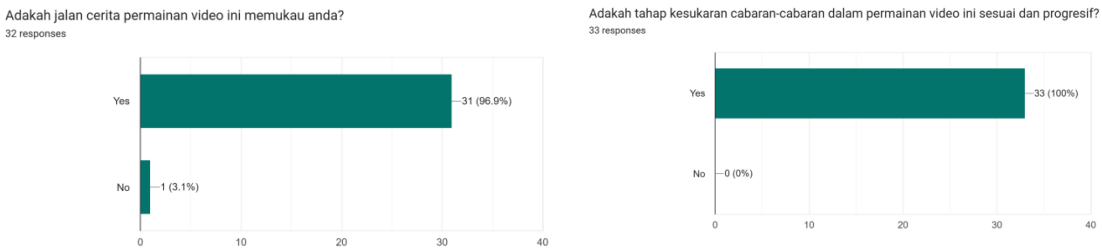
Figure 3 shows the respondents' feedback pertaining to the captivating visual graphics content and the satisfactory art style and aesthetics of the video game. These responses help determine the effectiveness of the product in meeting the second research objective, namely to create a video game with immersive visuals.



(a) (b)

Figure 3: Feedback (a) and (b) Regarding the Audience's Satisfaction with Gameplay Visual

All respondents expressed satisfaction with the visual graphics of the video game. Additionally, 31 out of 33 respondents found the game's style and aesthetics satisfactory. Meanwhile, Figure 4 demonstrates the respondents' feedback about the video game's storyline and whether the difficulty level of the challenges is appropriate and progressive. These responses help identify the storyline to be applied in the video game.



(a) (b)

Figure 4: Feedback(a) and (b) Regarding the Audience's Satisfaction with Gameplay Progression

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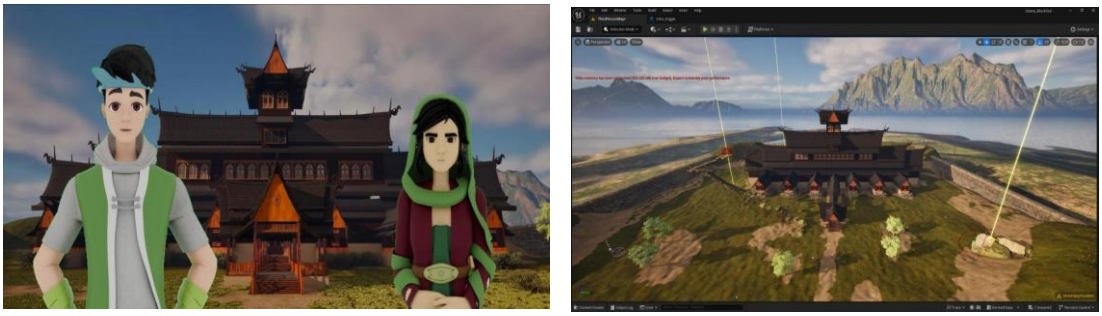
The majority of respondents were captivated by the game's storyline (96.9%), with only one respondent expressing dissatisfaction. All respondents agreed that the game's difficulty level was appropriate and progressed appropriately, with the level of complexity increasing at a pace that maintained engagement. Nevertheless, one respondent expressed dissatisfaction, indicating a potential area for improvement to ensure the narrative appeals to a wider audience. Figure 5 shows the final design of *Mahligai*, namely (a) the 3D-rendered characters and (b) the gameplay environment.



(a) (b)

Figure 5: Images (a) and (b) Illustrating the Final Gameplay Design of *Mahligai's* Characters and Environment

(a) (b)

Figure 6: Images (a) and (b) Illustrating the Final Design of *Mahligai's* Main Menu and Visual Gameplay

(a) (b)

Figure 7: (a) Exterior façade detail; (b) Full exterior reconstruction of *Istana Melayu Melaka* in *Mahligai*.

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The game's assets were meticulously optimized to ensure smooth and immersive gameplay, involving reductions in 3D model poly counts, texture optimization, and efficient memory and processing management. It enables the game to perform well even on lower-spec devices, thus minimizing lag and enhancing user experience. A key feature is the introductory animation, which combines rendered character scenes with detailed background scenes to create a visually engaging narrative that immerses players from the outset. The optimized assets and seamless integration of animated sequences ensure the game runs efficiently on various platforms, making it accessible to a broader audience. The analysis was conducted in reference to the research objectives to determine whether the immersive gameplay experience contributed to increased heritage awareness and positive engagement among adolescent participants.

DISCUSSION AND IMPLICATIONS

The findings from both qualitative and quantitative components collectively reinforce the viability of immersive digital reconstruction as a heritage preservation strategy. Building a digital reconstruction of the Malay Sultanate Palace is never a straightforward process, with detailed records remaining scarce and descriptions in manuscripts leaving room for interpretation. To mitigate such issues, the project leaned on two pillars: expert guidance and careful observation on site. The interview with Mr. Mohd Faizal bin Mamat @ Rahmat helped translate textual references into forms that make architectural sense. His long practice in visualizing Kota Melaka provided a working logic for elements such as layered roofs, main pillars, and the placement of pavilions. Field notes from the Museum of the Malay Sultanate Palace filled in visual cues that texts alone could not supply—carvings, proportions, interior chambers, and the way displays communicate court life. Together, these inputs anchored the 3D model used in *Mahligai* and reduced guesswork. The reconstruction developed in this study focused primarily on exterior architectural elements, as these components are more consistently documented in historical manuscripts and museum references. While interior spatial details remain less comprehensively recorded, the findings demonstrate that environmental scale, façade detailing, and interactive navigation alone were sufficient to produce meaningful visual immersion among youth participants.

Understanding the audience matters just as much. The first questionnaire, aimed at teenagers between 13 and 17, showed a clear appetite for interactive learning, especially when history is paired with strong visuals and a sense of exploration. The findings shaped design choices: artifact collection to guide attention, pop-up information to pace learning, and a structure that moves in stages. In other words, the gameplay was tuned to keep curiosity active while pointing back to cultural content.

The second survey, taken after gameplay, offered a reality check. Most players responded well to the graphics, the clarity of controls, and the storyline’s link to heritage. A few suggestions asked for refinements, such as adjusting the difficulty, smoothing navigation, or adding more contextual hints. These notes are not minor; they map the next steps and confirm that a heritage game must balance accuracy with usability. Failure to maintain a balance on each side will result in decreased engagement.

The results of this study suggest three points. First, historical descriptions alone are insufficient for precise reconstruction; expert interpretation and direct observation are needed to bridge gaps. Second, when cultural material is delivered through a playable form, young audiences are more likely to stay with it and remember it. Third, iterative testing, listening to users, and adjusting can turn a static reconstruction into a living resource. In this sense, *Mahligai* functions as both a teaching tool and a preservation method, showing how digital play can support heritage without losing sight of the record.

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CONCLUSION

This project is an attempt to keep the story of the Malay Palace of Malacca alive in a form that younger audiences can connect with. Instead of treating the palace merely as something found in books or museum displays, we tried to rebuild its presence in the digital space through the *Mahligai* video game. However, the work is not without difficulties. Historical records do not always describe architecture in ways that can be directly translated into models. For this reason, advice from experts, such as Mr. Mohd Faizal bin Mamat @ Rahmat, was essential. His practical knowledge and earlier projects gave direction to the way the palace was imagined and reconstructed in 3D.

Feedback from teenagers who played the game showed that they were not only interested in the history but also wanted a smooth, engaging game. Their responses reminded us that accuracy alone is not enough; heritage must also feel alive and enjoyable if it is to capture attention. In this way, the game becomes a bridge, combining educational aims with the type of interaction that players expect.

The *Mahligai* project demonstrates that cultural heritage does not have to be locked away in archives. With tools like Unreal Engine and Autodesk Maya, architecture and stories can be reshaped into experiences that travel far beyond museum walls. The project shows a pathway for how history can meet technology, and how young audiences can meet their heritage in a format they understand. The project emphasizes sustaining cultural memory rather than achieving absolute architectural precision. Future iterations of the *Mahligai* project may expand the reconstruction to include interior architectural spaces, enabling deeper experiential immersion and more comprehensive heritage interpretation.

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