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MAT KILAU SIDE SCROLLER RPG GAME: AN INNOVATIVE GAME-BASED LEARNING FOR CULTURAL HERITAGE EDUCATION

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Abstract:

The integration of cultural heritage into digital technologies presents new opportunities for innovation in both education and entertainment. This paper introduces Mat Kilau Side-Scroller RPG Game, an educational role-playing game (RPG) designed to revitalize history learning through interactive storytelling and gameplay. The project addresses the challenge of low student engagement in history subjects by embedding the story of Mat Kilau, a Malaysian national hero, into an immersive 2D side-scroller format that blends entertainment with educational objectives. The game was developed using the ADDIE instructional design model and implemented with the Unity game engine, incorporating sprite-based animation, narrative-driven mechanics, and an intuitive interface suitable for younger learners. A pilot study involving 30 primary school students was conducted to evaluate the game's usability, engagement, and educational value. Results indicate that the majority of participants found the game interesting, easy to understand, and effective in enhancing their knowledge of Mat Kilau's history. The innovation of this project lies in combining localized cultural storytelling with modern game design

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principles, demonstrating how computer science can support heritage preservation and digital literacy. Beyond its educational application, the game highlights potential for commercialization in the edutainment sector, providing an alternative pathway for integrating cultural narratives into digital platforms. This work contributes to the fields of Human-Computer Interaction, Mobile Game Development, and Computing Education, offering a replicable framework for developing culturally relevant educational games. Future work will expand the game's scope to include adaptive difficulty, multiplayer interaction, and immersive technologies such as AR and VR, thereby deepening learning engagement.

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Keyword:

Computing Education, Cultural Heritage, Digital Literacy, Educational Game, Human Computer Interaction, Role-Playing Game



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Introduction

History education is often seen as dull, particularly by younger students who prefer interactive and digital experiences. Conventional teaching approaches, while educational, often struggle to hold the attention of learners who are accustomed to vibrant, dynamic media. Meanwhile, the global gaming industry has expanded into a multi-billion-dollar market, boasting over 3 billion players worldwide as of 2023. This highlights the significant impact of games, which serve not only as entertainment but also as valuable tools for learning, skill development, and cultural engagement.

Educational games, particularly those with engaging storylines, can significantly enhance student motivation and improve learning outcomes. Role-playing games (RPGs) are particularly beneficial because of their immersive quality, which compels players to make choices, tackle challenges, and engage with characters in a narrative-focused setting. Nevertheless, in Malaysia, there is still a lack of localized educational games that incorporate national history and cultural heritage into interactive experiences.

In order to fill this gap, we created the Mat Kilau Side-Scroller RPG Game, an educational side-scrolling role-playing game that incorporates Malaysian history into an entertaining gaming experience. The game draws upon the narrative of Mat Kilau, a national hero celebrated for his fight against British colonialism in the 19th century. The primary contributions of this project include the following:

1. Development of a culturally inspired RPG that combines history education with entertainment.
2. Application of Human-Computer Interaction (HCI) and User Experience (UX) design principles to enhance engagement and learning outcomes.
3. Empirical evaluation with primary school students to assess the game's effectiveness in delivering both entertainment and historical knowledge.

Literature Review

Game-based learning has become a revolutionary method in education, providing students with engaging and personalized ways to acquire knowledge. Studies indicate that serious games significantly enhance motivation, improve knowledge retention, and foster critical thinking abilities. Role-playing games (RPGs), in particular, have been used not just for educational purposes but also for therapeutic reasons, identity exploration, and the development of social skills.

In Malaysia, history education has typically focused on memorization, leading to low levels of student engagement. To address this issue, researchers and educators are beginning to investigate the application of Information and Communication Technology (ICT), such as augmented reality (AR) and serious games, to improve history teaching. Despite this progress, there have been few projects aimed at integrating local cultural narratives into digital gaming. By incorporating Mat Kilau's legacy into an interactive format, this initiative seeks to bridge the gap, establishing games as tools for both education and cultural preservation.

Game-Based Learning in Computing Education

Game-based learning (GBL) integrates entertainment and pedagogy to create immersive environments that support cognitive development and learner motivation. Studies such as Hamilton, McKechnie, Edgerton & Wilson (2021) emphasize that well-designed games stimulate critical thinking and problem-solving, while Mayer (2024) note their potential to bridge the gap between traditional teaching and digital engagement. Within the Malaysian context, the Ministry of Education (Cheah, 2022) has encouraged the adoption of digital games to enhance creativity and 21st-century learning skills among students. Educational role-playing games (RPGs) further enhance experiential learning by enabling players to explore historical content interactively rather than memorizing facts passively (Chen, & Syu, 2024).

Human-Computer Interaction (HCI) and User Experience (UX) in Educational Games

Human-Computer Interaction (HCI) principles play a crucial role in ensuring that educational games are both accessible and engaging (Panda, 2025; Mohamed et al., 2025). According to Wickens, Helton, Hollands & Banbury (2021), effective interface design should promote ease of use, feedback, and emotional connection to maintain user satisfaction. Van Amstel & Gonzatto (2022) highlight that incorporating usability principles and user testing during game development leads to greater learner immersion and retention. In the context of educational RPGs, UX design plays a crucial role in striking a balance between challenge and reward, thereby ensuring that players remain motivated while achieving their learning outcomes (Casey, 2021).

Cultural Heritage and Digital Storytelling

Digital storytelling serves as a bridge between cultural heritage and modern education (Rizvic, Okanovic & Boskovic, 2020; Zort, Karabacak, Öznur & Dağlı, 2023). Gürsoy (2021) and Nicoli, Henriksen, Komodromos & Tsagalas (2022) argue that integrating traditional narratives with interactive technologies fosters emotional engagement and identity formation. In Malaysia, digital storytelling has been increasingly used to preserve folklore and national heritage (Abdullah, Isa, Wan Shamsuddin, Rawi, Mat Amin, Zain & Adzim, 2024). By transforming historical figures such as Mat Kilau into playable characters, Mat Kilau Side-Scroller RPG game exemplifies how localized digital storytelling can reinforce patriotism, historical awareness, and cultural pride among young learners (Mohamed et al., 2025; Jan & Din, 2025; Tengku Sabri, Md Syed & Shamshudeen, 2024).

Digital Literacy and Edutainment

Digital literacy encompasses not only the technical ability to use digital tools but also the capacity to think critically, communicate, and create within digital environments (Coskun, 2021). The concept of edutainment, combining education and entertainment, has proven particularly effective in promoting these skills among digital natives (Gee, 2003; Prensky, 2007). Through interactive gameplay, learners practice decision-making, strategic planning, and problem-solving in digital contexts (Sun, Chou & Yu, 2022; Hsueh, Shih, Chen & Tseng, 2025). The Mat Kilau Side-Scroller RPG game aligns with these objectives by encouraging exploration, storytelling, and reflection, thus strengthening students' digital competencies while making learning enjoyable.

Research Gap and Conceptual Direction

While many studies emphasize the advantages of game-based learning and cultural storytelling, there is a lack of research focused on how localized educational RPGs can enhance both digital literacy and cultural awareness in primary education. Current frameworks often overlook the evaluation of user experience and the design of human-computer interaction specifically tailored for younger learners. This study aims to fill these gaps by introducing the Mat Kilau Side-Scroller RPG Game as a model for educational gaming that prioritizes user experience and incorporates cultural elements, aligning with the evolving objectives of computing education and digital transformation in Malaysia.

Methodology

The development process was guided by the ADDIE instructional design model, which provided a structured framework for creating a game-based learning experience. **Figure 1** shows the ADDIE model.

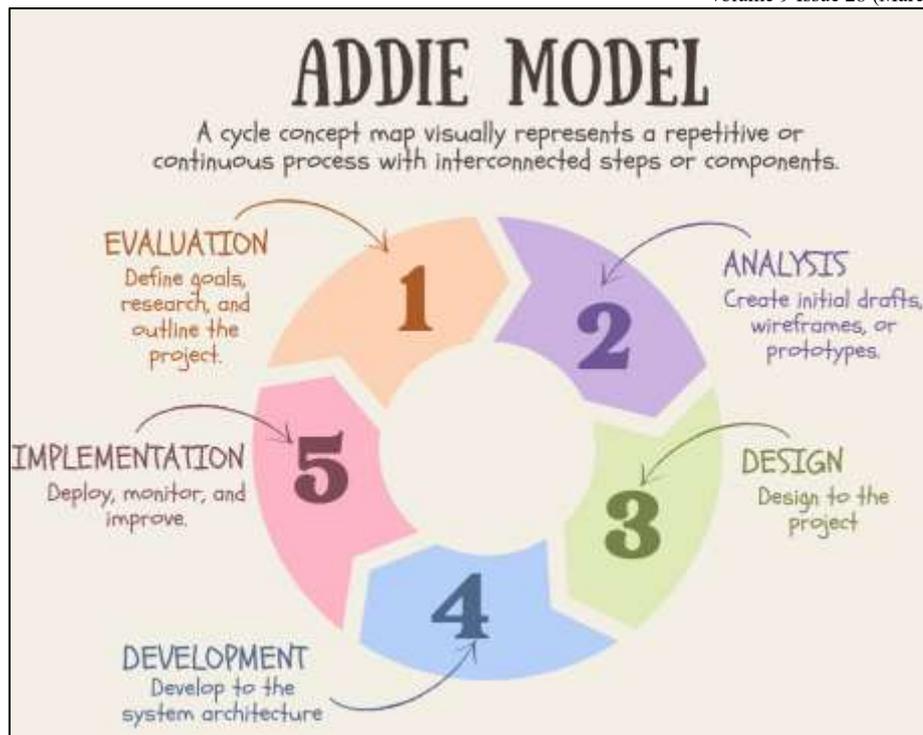


Figure 1: ADDIE Instructional Design Process Diagram

Figure 1 depicts the methodology process using the ADDIE Model. The illustration of a continuous or recurring process with linked steps or components is called a cycle concept map, including: -

- Analysis: Focused on the target demographic of primary school students aged 7 to 9 and recognized the necessity for innovative teaching methods for Malaysian history. The learning goals involved comprehending Mat Kilau's contributions to resisting colonialism and cultivating a sense of appreciation for national heritage.
- Design: Developed the game's narrative, side-scrolling elements, and user interface, ensuring historical accuracy while maintaining age-appropriate interactivity.
- Development: Created the game using Unity, featuring sprite animations, sound effects, and user-friendly controls. The gameplay mechanics encompassed exploration, combat, and interactive storytelling.
- Implementation: Performed pilot usability testing utilizing Unity Remote on Android devices to confirm performance reliability and user accessibility.
- Evaluation: Collected feedback by surveys and observations from students to assess engagement, usability, and educational effectiveness.

Innovation and System Architecture

The game's uniqueness stems from its blend of cultural narratives and contemporary gameplay elements. In contrast to typical RPGs, the Mat Kilau Side-Scroller RPG Game is rooted in Malaysian legends, enabling players to experience Mat Kilau's transformation from a simple villager to a national hero. Figure 2 illustrates the game's system architecture.

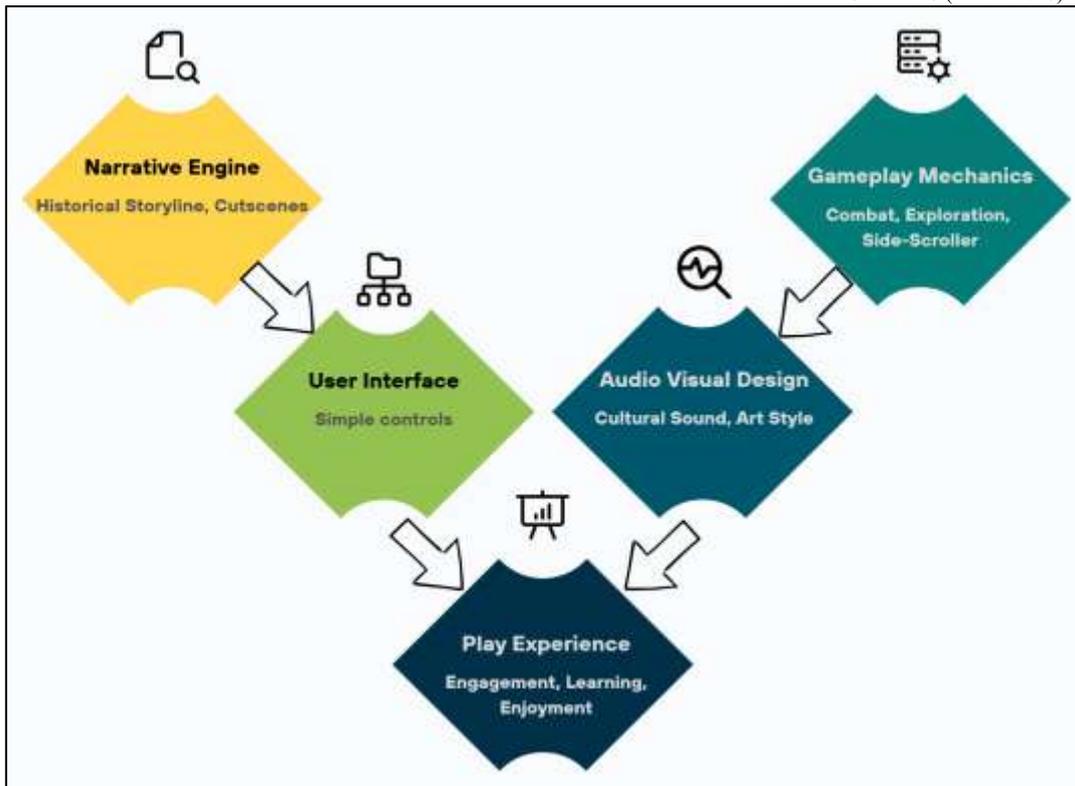


Figure 2: System Architecture for Mat Kilau Side-Scroller Game

The system architecture from Figure 2 integrates how the narrative engine, gameplay mechanics, user interface (UI/UX), and audio-visual design interact in the innovative game. There are: -

- Narrative Engine: Branching dialogues and cutscenes to present historical context.
- Gameplay Mechanics: Side-scrolling exploration, platforming, and combat sequences against colonial forces.
- User Interface: Simplified controls and vibrant visuals designed for younger learners.
- Audio-Visual Design: Authentic cultural soundscapes and visual motifs inspired by 19th-century Pahang.

This integration demonstrates how innovations in computer science can be applied to cultural and educational contexts in game design.

Evaluation

The purpose of the evaluation was to determine how effectively the Mat Kilau Side-Scroller RPG game captivates students, improves digital literacy, and promotes cultural learning. The assessment framework was based on principles of Human-Computer Interaction (HCI) and User Experience (UX), focusing on usability, enjoyment, and educational results.

A pilot study was conducted with 30 students at SK Kota Raja, Panchor, Johor. Participants interacted with the game during a 30-minute session, followed by a structured questionnaire consisting of demographic data and five key evaluation dimensions:

- Engagement and Interest – students’ enjoyment and attention during gameplay.
- Educational Value – perceived learning of Mat Kilau’s story and Malaysian history.
- Usability and Accessibility – ease of understanding controls, navigation, and interface.
- Aesthetic Appeal – satisfaction with visuals, characters, and sound.
- Overall Satisfaction – general impressions and perceived value of the game.

Each criterion was rated using a five-point Likert scale (1 = Strongly Disagree, 5 = Strongly Agree). Open-ended questions elicited qualitative insights into gameplay experience and learning reflections.

Results and Discussions

Data were collected using Google Forms and analyzed quantitatively to determine frequency distributions and average scores for each assessment criterion. Qualitative comments were thematically coded to recognize trends in user perceptions. The analysis combined descriptive statistics with metrics for evaluating user experience, aligning with established HCI and UX assessment frameworks (Wickens, Helton, Hollands & Banbury, 2021; Van Amstel & Gonzatto, 2022).

The findings indicate strong positive responses across all criteria. Figure 3 shows all criteria.

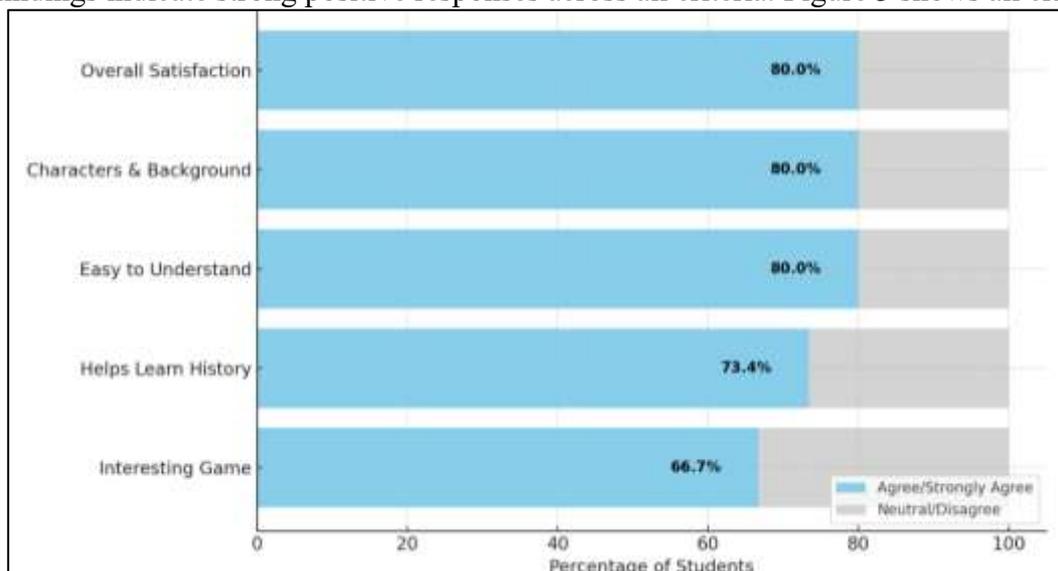


Figure 3: Students Evaluation to the Mat Kilau Game

Overall, the results from **Figure 3** indicated a high level of engagement and satisfaction among participants. There are: -

- Engagement: There are 80.0% of participants strongly agreed that the game was interesting, demonstrating its ability to capture attention.
- Usability: About 80.0% agreed the game was easy to understand, confirming age-appropriate design.
- Educational Value: A total of 73.4% agreed that the game helped them learn about Mat Kilau’s history, validating its role as a learning tool.

- **Aesthetic Appeal:** There are 66.7% appreciated the characters and backgrounds, highlighting the importance of visual storytelling.
- **Overall Satisfaction:** 80% of participants expressed satisfaction, indicating a successful balance between education and entertainment.

These results support the argument that localized educational games can enhance historical literacy while providing engaging digital experiences. Moreover, the study underscores the potential of such innovations to be integrated into formal and informal educational settings.

This work contributes to three main areas:

- **Educational Impact:** Enhances history learning through interactive storytelling and critical thinking.
- **Cultural Impact:** Preserves Malaysian heritage by embedding national heroes into digital platforms.
- **Technological Impact:** Provides a replicable framework for developing culturally relevant RPGs using contemporary game engines and user experience (UX) principles.

Additionally, the project allows market potential in the growing edutainment sector, offering opportunities for commercialization and societal impact.

Conclusion

This research highlights the effectiveness of educational role-playing games (RPGs) in merging cultural heritage with contemporary gameplay, making history more appealing to younger audiences. The Mat Kilau Side-Scroller RPG successfully fuses storytelling, interactive elements, and user-friendly design to deliver both entertainment and educational benefits.

For future development, the game could be improved further in the quiz section and technically incorporate adaptive gameplay difficulty levels, with multiplayer options and features such as augmented or virtual reality to enhance immersion. Additionally, larger-scale studies could be pursued to assess long-term learning impacts and the potential for scalability to other historical figures and themes.

The findings of this study indicate that innovations in game-based learning, such as the Mat Kilau Side-Scrolling RPG, have the capacity to advance educational technology, boost digital literacy, and preserve cultural heritage. By blending cultural narratives, user-experience-driven design, and innovative teaching methods, this project serves as a model for integrating computer science and digital education to create engaging, impactful, and sustainable learning opportunities.

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