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3d Chess Piece Assets In The Singosari And Kediri Kingdom Style

Ramdlan Siraj Rio Brilian Anugrah[1], Saiful Yahya[2*]
[1,2]Desain Komunikasi Visual / Universitas Bhinneka Nusantara
[1]riodkv2@gmail.com,[2]yahya@ubhinus.ac.id

ABSTRAK
Permainan catur menjadi salah satu permainan board game tertua yang sampai sekarang dimainkan oleh semua kalangan. Penelitian ini bertujuan untuk merancang aset 3D bidak catur yang mempresentasikan tokoh-tokoh sejarah dari Perang Ganter antara Kerajaan Kediri dan Singosari. Penelitian ini digunakan sebagai media edukatif dan pelestarian sejarah melalui pendekatan desain kreatif berbasis teknologi 3D. Metode Penelitian yang digunakan adalah Design Thinking, meliputi tahapan Empathize, Define, Ideate, Prototype dan Test. Data diperoleh melalui observasi di Museum Singosari dan Museum Panji, Studi literatur, serta wawancara dengan ahli sejarah, pembuatan model dilakukan menggunakan perangkat lunak Blender 3D dengan gaya mid-poly agar efisiensi untuk media digital maupun cetak 3D. Hasil penelitian menghasilkan dua set bidak catur 3D, sisi Putih mewakili Tumapel dan sisi hitam mewakili Kediri. Setiap bidak memiliki bentuk, atribut, dan warna yang disesuaikan dengan referensi sejarah serta proporsi standar permainan catur. Guna memastikan efektivitas produk, evaluasi kuantitatif terhadap target audiens menghasilkan skor rata-rata 3,664 (pada skala Likert 4 poin). Sesuai dengan penilaian dari sejarawan dan pakar 3D yang menyatakan bahwa aset yang dikembangkan memenuhi kriteria utama dalam hal estetika, akurasi historis, nilai edukatif, inovasi, dan potensi komersial.. Harapan dari penelitian ini adalah kolaborasi dengan bidang ilmu yang lain untuk mewujudkan menjadi permainan catur 3D Digital.
Kata Kunci: *catur, aset 3d digital, desain thinking, kerajaan singhasari*

ABSTRACT
Chess is one of the oldest board games that is still played by people of all ages today. This research aims to design 3D chess piece assets that represent historical figures from the Ganter War between the Kediri and Singosari Kingdoms. This research serves as an educational medium and a form of historical preservation through a creative design approach based on 3D technology. The research method used is Design Thinking, including the stages of Empathize, Define, Ideate, Prototype, and Test. Data was obtained through observations at the Singosari Museum and the Panji Museum, literature studies, and interviews with historians. Model creation was done using Blender 3D software with a mid-poly style for efficiency in both digital and 3D print media. The research results produced two sets of 3D chess pieces, with the white side representing Tumapel and the black side representing Kediri. Each piece has a shape, attributes, and color that are customized to historical references and standard chess game proportions. To ensure the product's effectiveness, a quantitative evaluation of the target audience yielded a mean score of 3.664 (on a 4-point Likert scale). Furthermore, assessments by historians and 3D experts confirm that the developed assets satisfy key criteria in aesthetics, historical accuracy, educational value, innovation, and commercial potential. The hope of this research is to collaborate with other fields of science to realize it as a 3D Digital Chess game.
Keywords: *chess, 3d asset digital, design thinking, singhasari kingdom*

Introduction

One of the most influential events that occurred in the Nusantara was the conflict between the Kediri Kingdom and the Tumapel Dukuh in the 13th century AD. Kediri, which was previously the center of power in East Java, weakened after the emergence of a new force in Tumapel under the leadership of Ken Arok. Due to Ken Arok's desire to become king and declare Tumapel's independence, the Ganter War occurred. Prior to this, Tumapel was a territory under the rule of the Kediri Kingdom. Thanks to the help of the sages, Ken Arok fought against Kertajaya, the ruler of Kediri. The battle took place in the Ganter area, which is now known as Malang. Ken Arok's success in that war not only liberated Tumapel but also solidified his steps to conquer Kediri and establish a new kingdom called Singosari. This event holds significant historical value because the Singosari Kingdom would later become the precursor to the establishment of Majapahit (Susilo & Sarkowi, 2021). However, the details of the figures involved in the war on the sides of Kertajaya and Ken Arok are not explained in detail in historical sources, so this research attempts to reconstruct them through a descriptive approach. In the current context, efforts to introduce history to the younger generation can be done through communicative and interactive media. History learning in the digital age often faces challenges because the delivery media is still static and textual, making it less capable of attracting the attention of young audiences. Therefore, there is a need for three-dimensional (3D) technology-based media, which is one solution because it can present historical objects more realistically, immersively, and communicatively. Historical messages are conveyed visually, dynamically, and interactively to make them more engaging and easier to understand (Riyana & Setiawan, 2023).

Chess is one of the mediums that has strategic value aligned with the meaning of warfare, namely tactical calculation, troop control, and territorial conquest. Additionally, chess in Indonesia has also seen significant development. PB Percasi has improved the tiered athlete development system, regularly holds both offline and online tournaments, and established the Indonesian Chess Museum as a center for documenting the history of national chess (Antara, 2025). Recent developments indicate that chess activity in Indonesia is on the rise. For example, approximately 401 people from 18 provinces participated in the JAPFA Year End Tournament 2023, with early age categories such as U-12 and U-16, serving as a platform for athlete development from a young age (Kemenpora, 2023).

Additionally, international tournaments like the Indonesian GM Tournament 2025, which brings together local and international chess players with a total prize fund of US 5,000, demonstrate sponsor support and significant opportunities for Indonesian chess players to achieve success on a global scale (Berita Satu, 2025). This fact shows that chess in Indonesia is not only surviving but also continuing to develop in line with the dynamics of the times.

Other research indicates that playing chess not only serves as a sport but also contributes to improving students' strategic thinking skills and academic performance (Sanjaya & Febriandirza, 2023). Chess tasks, such as solving problems and planning moves, directly contribute to the development of strategic and logical thinking in children and adults (Dvoryatkina, S.N., 2019). This fact confirms that chess has dual potential, serving as both a form of entertainment and an educational medium. However, to date, there have been limited efforts to connect local historical narratives with chess game trends, even tho integrating the two could provide an engaging educational medium for modern society. The scarcity of digital visual materials depicting the Kediri and Singhasari conflict is a constraint in presenting the history in an engaging manner. As a result, this research focuses on creating 3D chess piece assets by adapting characters from Tumapel and Kediri. Beside being a form of historical preservation through a creative approach, this work is also expected to support

the chess playing trend in Indonesia while presenting relevant educational products and merchandise.

Chess, a classic strategy game, has six main pieces with different functions. Technological advancements allow this game to be adapted into a digital form with innovative piece visualization. This opens up the opportunity to introduce 3D assets based on historical figures from the Ganter War, so that each chess piece has both educational value and visual uniqueness. Chess media was chosen because it can feature characters from the Ganter War while also serving to sharpen memory and increase knowledge. This research is urgent because public interest in local history tends to decline, especially among young people who are more interested in digital entertainment media than cultural learning. The use of interactive media such as 3D assets can increase user motivation and engagement in the history learning process (Anggraini, 2025). Therefore, developing digital media based on 3D assets is a strategic step in reintroducing history to the public through a more modern and engaging approach. The choice of the Ganter War theme is based on its historical value as a significant event in the history of the kingdom in East Java, which became a symbol of power shifts and the precursor to the establishment of Majapahit. Meanwhile, the mid-poly style was chosen for asset creation because it provides a balance between visual detail and technical efficiency. Using mid-poly modeling techniques can produce sufficiently detailed shapes without burdening the rendering process, making it effective for both interactive media and educational animations (Lan, 2024).

Methods

This research uses initial data collection from literature studies and field observations. Literature studies were conducted to understand the characters in the Singhasari Kingdom and the Kediri Kingdom. Literature studies used data sources such as books, articles, and other supporting documents relevant to the research topic. The observation activity was conducted at two museums, namely the Panji Museum and the Singhasari Museum, for the purpose of observing the dioramas in both museums.

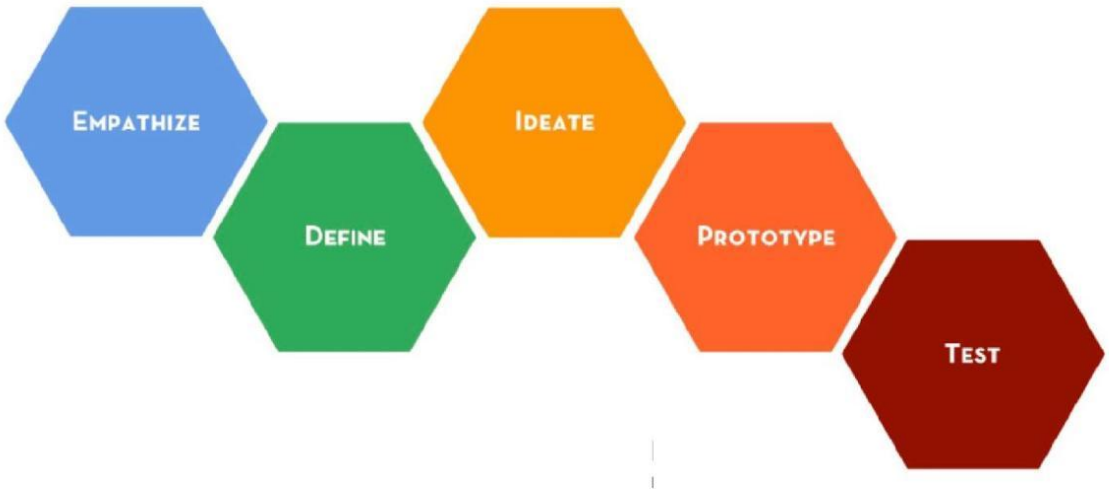

Figure 1. Design Thinking Methods (Yahya, 2025)

This research uses the Design Thinking design method, focusing on solving existing problems and then providing solutions to address them using creative solutions. Design

thinking is a method used to solve problems by developing innovations with a focus on user needs. This is achieved through stages and steps that emphasize understanding, exploration, and the implementation of effective solutions (Yahya, 2025).

1. empathize

The initial stage of the design thinking method focuses on the comprehensive effort to understand user needs and experiences. This process is carried out through activities such as observation, interviews, and direct interaction with relevant stakeholders to identify their problems, needs, and expectations (Yahya, 2024). In the context of this research, the empathize stage is directed at gaining a profound understanding of the problems faced by the Singhasari Museum and Panji Museum, particularly in the presentation of digital content regarding the Ganter War.

2. define

At this stage, all data and findings from the empathize process are analyzed and synthesized to formulate a core problem statement that needs to be addressed (Yahya, 2024). Its main purpose is to synthesize information gathered during the empathy phase and clearly articulate the core problem or challenge to be addressed. This step transforms broad observations and user insights into a focused, actionable problem statement, often called a "point of view" (Wilkerson, 2021). The primary objective of this stage is to define the problem clearly, thereby focusing the direction for solution development. In the context of this research, the define stage is used to identify the needs of the Singosari Museum and Panji Museum for digital media capable of presenting the story of the Ganter War in an engaging manner. The analysis revealed a need for the development of 3D assets in the form of Singosari-style and Kediri-style chess pieces to serve as a visual educational medium and a means for preserving local history.

3. ideate

The ideate stage is the process of generating a wide range of creative ideas to address the previously defined problem. This process is carried out through activities such as brainstorming, mind mapping, and visual idea exploration to discover innovative solutions. Brainstorming is a widely used, intuitive method in the ideate phase, helping designers generate a broad range of ideas and stimulate creative thinking (Kim. T., 2019). Mind mapping is a visual, diagram-based tool that supports divergent thinking and creative association. In graphic design education, mind mapping has been empirically shown to play a crucial role in the pre-conceptualization phase, helping designers develop creative ideas, stimulate their minds, and maintain sustainable creativity (Dong, Y., 2021). In the context of this research, the developed idea involves the creation of 3D assets of chess pieces styled after the Singosari and Kediri Kingdoms, representing the figures and attributes of the Ganter War. These 3D assets are designed not only as visual works but also as interactive educational media that can enrich the digital content of the Singosari Museum and Panji Museum regarding the history of the Ganter War.

4. prototype

The process of developing the 3D asset prototype was conducted through three main stages: pre-production, production, and post-production (Zhang, 2023). The pre-production stage involved conceptual visual design, gathering historical references, compiling mood boards, and creating initial designs for the chess pieces based on attributes of the Singosari and Kediri Kingdoms. The production stage focused on 3D modeling, which included modeling, sculpting, retopology, and vertex painting. Meanwhile, the post-production stage encompassed the process of setting bounding box dimensions and final adjustments to prepare the assets for use as digital assets or for 3D printing needs. This prototype emphasizes the symbolic representation of the Ganter War through the form and attributes

of each chess piece, adapted from diorama references and visual information obtained from the Singosari Museum and Panji Museum.

5. evaluate

This stage was conducted to evaluate the design results of the Singosari and Kediri-style 3D chess piece assets. The testing aimed to assess the design's alignment with the Ganter War theme, its aesthetic value, and its appeal as a historical education medium. The method employed was a Likert scale (Sugiyono, 2008), involving a History Expert, a 3D Modeling Expert, and members of the General Public as the target audience to gather feedback on the visual quality and the message conveyed.

Discussion

1. Emphatize

The first observation was conducted at the Panji Museum on October 8, 2024. This museum features a diorama of the Ganter War depicting the Kediri and Tumapel forces. However, an interview with Ms. Ratna, a museum educator, revealed that some of the soldier attributes in the diorama are not fully accurate and remain static in nature. The diorama depicts the Ganter War, showcasing not only the battle scene but also the strategy employed by the Tumapel forces (who would later establish the Singhasari Kingdom) against the ranks of the Kediri Kingdom's army. The diorama illustrates how the Tumapel forces leveraged their natural surroundings to support their military tactics, in contrast to the Kediri Kingdom's army, which displayed a meticulously structured strategy, forming orderly rows and groups to assault the Tumapel forces.

Figure 2: Diorama Ganter Wars at Museum Panji

The second observation, conducted at the Singhasari Museum on October 16, 2024, indicated that although the museum holds an extensive archaeological collection—including statues, keris (daggers), and a diorama of the Ganter War—it currently lacks digital media or assets that provide visualizations of the historical figures.

Other data searching was also conducted through a literature review and an analysis of journal data concerning interest in the game of chess. The research results indicate that public interest in chess is notably high (Natasya, 2025; Merdeka, 2025). However, few educational media exist that connect it with local historical narratives.

2. Define

Based on the comprehensive understanding gained from the Empathize stage, the next critical step is to define the core problems and needs precisely. This stage synthesizes the insights from observations and literature studies to formulate a clear and actionable problem

statement, which will guide the subsequent ideation and prototyping phases. The analysis reveals a multi-faceted challenge at the intersection of history education, public engagement, and digital media. The primary issue is the low engagement of the public, particularly the younger generation, with local history, specifically the narrative of the Ganter War between the Tumapel Dukuh and the Kediri Kingdom. This is exacerbated by several key factors:

a. Static and Non-Interactive Historical Presentation: The existing media in museums, such as dioramas at the Singhasari and Panji Museums, are primarily static and textual. They lack the dynamic, immersive, and communicative qualities needed to capture the attention of a generation accustomed to digital interactivity.
b. Lack of Visually Compelling Digital Assets: There is a significant scarcity of detailed and engaging digital visual materials, specifically three-dimensional (3D) assets, that depict the figures and attributes of the Ganter War. This gap limits the potential for creating modern and attractive educational content.
c. Disconnect Between Historical Narrative and Contemporary Trends: While chess is experiencing a notable surge in popularity and development in Indonesia, and is inherently linked to strategic warfare concepts, there has been no concerted effort to leverage this trend as a vessel for local history education.

Therefore, the core problem is defined as: The need for an innovative, visually engaging, and interactive digital medium to present the history of the Ganter War in a way that resonates with modern audiences and aligns with contemporary interests. Based on this problem definition, the specific needs for this research are formulated as follows:

a. The need to develop detailed 3D visualizations of the key figures from the Kediri and Tumapel (Singhasari) sides, for which historical sources provide limited detail.
b. The need to create an educational product that functions not only as a preservation tool but also as an engaging medium that can sharpen strategic thinking and improve historical knowledge.
c. The need to bridge the gap between cultural heritage and modern digital entertainment by integrating a local historical narrative into a popular and strategically relevant game like chess.

Consequently, this research defines its solution direction as: The development of 3D asset prototypes in the form of chess pieces, stylized with the attributes and characters of the Singhasari and Kediri Kingdoms, based on the Ganter War narrative. These assets are intended to serve as a visual educational medium and a creative means for preserving local history, ultimately aiming to increase motivation and engagement in the history learning process through a more modern and interactive approach.

3. Ideate

Following the precise problem definition established in the previous stage, the Ideate phase was conducted to generate a range of creative and innovative solutions. The objective of this stage was to explore diverse possibilities for creating a medium that addresses the challenge of low youth engagement with the history of the Ganter War, while simultaneously leveraging the contemporary trend of strategic games.

A brainstorming process was undertaken, considering three primary aspects: historical educational value, visual and interactive appeal, and relevance to the modern context. From this process, several potential concepts emerged. After a thorough selection process, the chosen concept was the development of 3D chess piece assets adapted from the characters and attributes of the Tumapel (Singhasari) and Kediri Kingdoms.

This core idea was then elaborated into several detailed conceptual components:

The "Playable History" Concept: The fundamental idea is to transform a static historical narrative into an interactive experience. By representing historical figures as chess

pieces, users do not merely read about the Ganter War; they can simulate the strategic conflict on the chessboard. This concept leverages the intrinsic value of chess as a game of strategy, which is inherently aligned with the tactical realities of warfare, thereby facilitating implicit learning through gameplay mechanics.

Visualization and Characterization of Historical Figures: Each chess piece is designed to represent a specific role and hierarchy within both the historical and game contexts.

a. King: Represented by Ken Arok (Tumapel/white side) and King Kertajaya (Kediri/black side), as the central figures of the conflict.
b. Queen: Could represent spiritual power or a key advisor, such as a Shiva Priest or a trusted confidant, reflecting the influential role of brahmins and sages in the conflict.
c. Rook: Symbolizes the fortress or architectural strength of the kingdom, embodied through forms inspired by the defensive architecture of each kingdom.
d. Bishop: Represents war commanders or elite troops, often associated with war elephant units in ancient Javanese context.
e. Knight: Depicts the cavalry or mounted units that served as the mobile vanguard in warfare.
f. Pawn: Designed as standard infantry soldiers from each kingdom, featuring distinctive weaponry and battle attire.

Color Symbolism and Visual Narrative: The choice of black and white serves not only to distinguish the two sides on the chessboard but is also imbued with deep narrative meaning. The black side (Kediri) symbolizes the old order—a majestic but fading power. In contrast, the white side (Tumapel) represents enlightenment, a reformist movement, and the birth of a new authority under Ken Arok. This visual contrast reinforces the narrative of the conflict as a cosmic struggle between two forces that gave rise to a new balance in the archipelago's history.

Application of Mid-Poly Style and Historical Accuracy: From a technical standpoint, a mid-poly modeling approach was selected for creating the 3D assets. This style was chosen because it effectively captures the essential details of the figures' attire and attributes (based on references from the Singhasari and Panji Museums) without creating models that are too computationally heavy for use in interactive digital applications or for potential future 3D printing for merchandise.

Thus, the Ideate phase yielded not just the idea of 3D chess pieces, but a mature and cohesive conceptual framework where every design element—from form and color to the role of each piece—is synergistically integrated to create an educational medium that is communicative, engaging, and rich in meaning.

4. Prototype

The development of the prototype for the 3D chess piece assets themed around the Ganter War between Tumapel (Singhasari) and Kediri was conducted through a structured pipeline, segmented into three primary phases: pre-production, production, and post-production. This systematic approach ensured that the assets were both historically grounded and technically optimized for their intended use.

a) Pre-Production

This initial phase focused on establishing a solid conceptual and visual foundation. The primary activity was the collection of mood boards and references. Visual materials, including photographs of dioramas, historical illustrations, and architectural motifs from the Singhasari and Kediri periods, were compiled and analyzed. These references were crucial

for informing the design language, anatomical proportions, and symbolic attributes of each chess piece, ensuring their designs were aligned with the historical and cultural context.

Figure 3: Visual Reference

b) Production

The production phase involved the technical creation of the 3D assets, encompassing several critical sub-stages:

3D Shape Design: This process began with importing reference images into the 3D software (e.g., Blender or ZBrush) to serve as guides for accurate proportions. The core 3D modeling then commenced, using basic geometric shapes to block out the primary forms of each character.

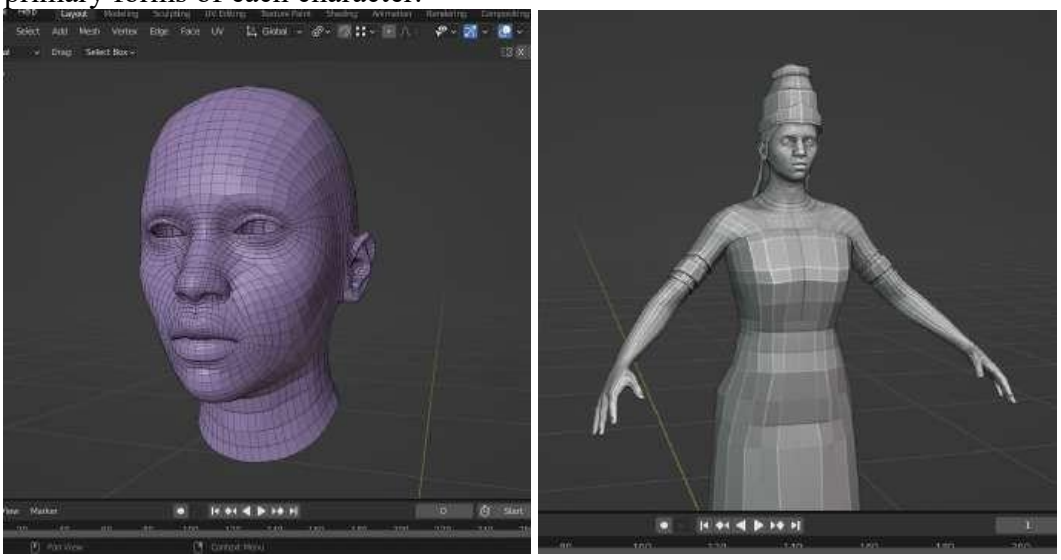

Figure 4: Basic Shape modeling 3D

Detailing Model: Following the initial block-out, finer details such as clothing folds, armor textures, weapon ornaments, and facial features were sculpted or modeled to enhance the visual fidelity and character of each piece.

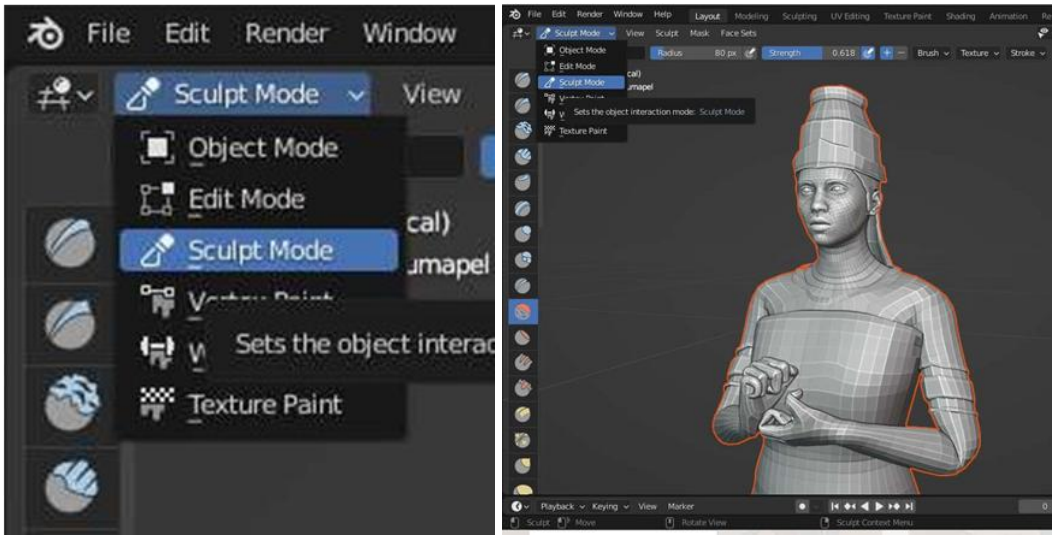

Figure 5: Detailing Model using Sculpting

Retopology: To ensure the models were efficient for potential use in real-time applications (such as games or interactive media), a retopology process was performed. This step restructured the model's mesh into a cleaner, lower-polygon count while preserving the high-resolution details from the sculpting phase.

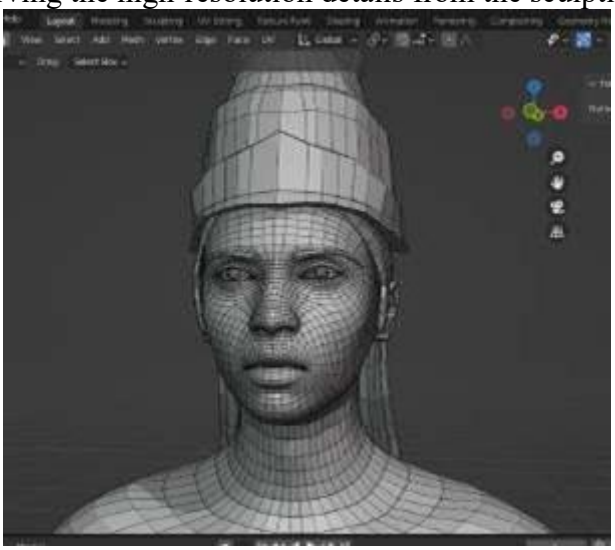

Figure 6: Retopology Object

Vertex Painting: Basic colors and material definitions were applied directly to the model's vertices (vertex painting) to establish the foundational color scheme, adhering to the established symbolism of black for Kediri and white for Tumapel.

c) Post-Production

The final phase prepared the assets for practical implementation. The key step here was the determination of *bounding box dimensions*. A uniform bounding box was established for all pieces to ensure consistent scale, alignment, and behavior, whether for digital rendering on a virtual chessboard or for future 3D printing as physical objects. Final adjustments were made to optimize the assets for their ultimate application.

Figure 7: Setup Bounding Box Dimension

This comprehensive workflow, from conceptual reference to technically refined model, ensured the successful creation of a prototype that is visually compelling, historically resonant, and functionally robust.

Figure 8: Final Result 3D Asset Chess Pieces

5. Evaluate

The evaluation stage was conducted to assess the design, historical accuracy, and overall appeal of the prototype 3D chess piece assets. A multi-faceted testing approach was

employed, gathering feedback from a 3D modeling expert, a history expert, and the general public to ensure a comprehensive validation of the prototype.

The first test was conducted with Mr. Dimas Ramadhan, a 3D Artist at Muse Akademi, to evaluate the technical and aesthetic aspects of the models created in Blender. The expert provided several crucial recommendations: 3D Printing Preparation: For physical fabrication, the models must be adjusted to real-world scale and exported in the STL file format to ensure compatibility with 3D printing software and prevent dimensional distortions. Modeling Technique: While the chosen mid-poly style was acceptable for maintaining efficiency, the expert suggested considering a high-poly approach for applications requiring high-detail visual output, such as digital exhibitions, to achieve a more realistic and refined result. Technical Integrity: It was emphasized to maintain the objects within their designated bounding boxes and ensure the proportions of small parts were robust enough to survive the 3D printing process without damage. Conclusion from the 3D expert: The models are technically sound but require adjustments for print readiness, including real-world scaling, STL export, and a potential increase in polygon count for high-fidelity use cases.

The second test involved Mr. Dwi Cahyono, Owner of the Panji Museum and a local East Javanese history scholar. The evaluation focused on historical authenticity and symbolic representation. Overall Concept: The visual forms were deemed appropriate and aligned with the historical concept of the Ganter War. Symbolic Depth: The expert recommended enriching the design by ensuring that every attribute and weapon stance carried a deeper symbolic meaning consistent with each figure's role in the conflict. He advised using historical sources like ancient statues (arca) and the Pararaton manuscript as primary references for character posture and attributes to enhance historical accuracy. Conclusion from the history expert: The visual foundation is strong, but the assets require refinement to embed more profound symbolic meaning based on authoritative historical sources.

Following the prototype development, an evaluation was conducted with the general public to assess the quality, appeal, and appropriateness of the 3D chess piece assets. A questionnaire consisting of 19 items was distributed to the target audience after they viewed the 3D assets and their implementation, the 19 questions were divided into 5 sections, namely visual aesthetics, educational value, design innovation, historical interest and commercial potential.

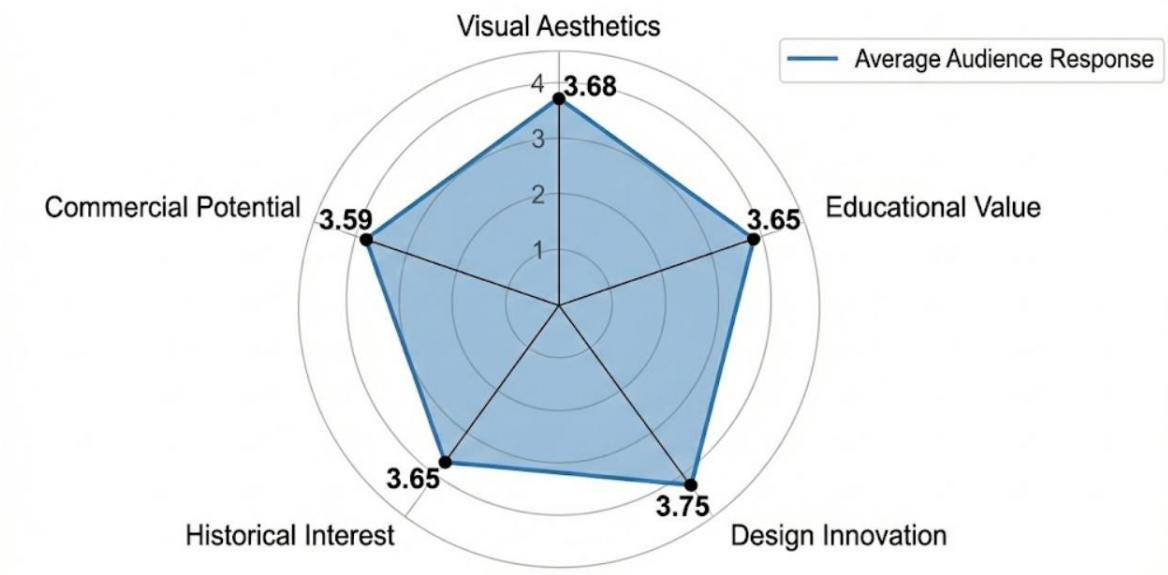

Figure 9. Radar chart illustrating the multidimensional evaluation of the "Perang Ganter" 3D Chess Piece prototype. The graph visualizes the mean response scores based on a 4-point Likert scale across five key parameters: Design Innovation, Visual Aesthetics, Educational Value, Historical Interest, and Commercial Potential.

As depicted in Figure 1, the product performance evaluation was conducted using a holistic approach covering five crucial dimensions of creative educational media development. The radar chart exhibits an expansive pentagonal pattern with a relatively homogeneous distribution in the upper quartile (score > 3.50 out of a maximum of 4.00), indicating consistent positive acceptance from the respondents. Specific analysis of the axes reveals that Design Innovation achieved the highest mean score ($\bar{X}$ = 3.75). This validates the research hypothesis that integrating the historical narrative of the Ganter War into chess game mechanics is perceived as a significant novelty in the realm of creative engineering. This finding correlates linearly with the high Visual Aesthetics score (3.68), confirming that the complexity of 3D ornamentation and accuracy of historical references were executed effectively without compromising the ergonomic function of the pieces. Furthermore, the product's cognitive impact is confirmed through identical scores in Educational Value and Historical Interest (3.65). This demonstrates the effectiveness of interactive media in stimulating audience attention toward local historical narratives. Although Commercial Potential recorded the relatively lowest score (3.59), the value remains well within the 'Highly Via`ble' category. This suggests that, beyond serving as a medium for cultural preservation, the product possesses strong economic viability for market penetration as merchandise or collectibles.

The results demonstrated an overwhelmingly positive reception, with all assessed aspects receiving high scores and being categorized as "Very Feasible." The public audience evaluation conclusively validates the success of the 3D chess asset prototype. The data confirms that the assets are not only visually appealing, historically resonant, and educationally effective but also possess strong commercial potential. The highly positive reception of the core innovative concept indicates that this approach successfully bridges the gap between cultural heritage and interactive entertainment, effectively engaging the modern audience as intended.

Conclusion

The public audience evaluation conclusively validates the success of the 3D chess asset prototype. The data confirms that the assets are not only visually appealing, historically

resonant, and educationally effective but also possess strong commercial potential. The highly positive reception of the core innovative concept indicates that this approach successfully bridges the gap between cultural heritage and interactive entertainment, effectively engaging the modern audience as intended.

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