

Liaozhai(聊斋) in the Mirror: Exploring Gender Bias and Awareness through Utilizing Serious Games for Gender Education

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Abstract

This paper presents “Liaozhai in the Mirror,” a serious educational game designed to promote gender equality through an interactive visual storytelling environment enhanced by AI-generated content. The game uses generative AI (GenAI) to show a novel approach to gender education in schools and universities. Drawing inspiration from “Strange Stories from a Chinese Studio (Liaozhai Zhiyi 聊斋志异)” and the edutainment concept, the game’s visual storytelling significantly influences the narrative outcomes based on the player’s understanding of gender issues. These issues encompass topics such as dating relationships, the role of bystanders, gaslighting, dating violence, gender equality, and consent. The player’s choices directly affect the trajectory and end of the character’s story, with outcomes ranging from unfortunate to enlightening, thereby underscoring the importance of gender education. AI generates 14,348,907 possible outcomes of the same character for different answers through large language models (LLMs) to generate texts and images, and each result is the same in terms of good and bad endings, but the stories vary in diversity.

Keywords

Gender Relationships, Serious Games, Gender Bias, Gender Education, Cultural Education, Game Mechanics

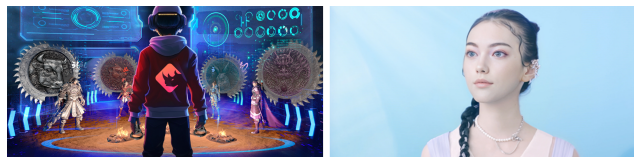
Introduction

Educational games play an increasingly vital role in addressing social issues such as gender equality [34] [15], utilizing immersive narratives to broach sensitive topics indirectly [21] [10]. Philosophical support for playful and engaging learning experiences, such as those posited by Plato, echoes the effectiveness of educational games in fostering knowledge and understanding. This study scrutinizes “Liaozhai in the Mirror,” an educational game that leverages Chinese folklore to facilitate gender education. By integrating generative AI, the game dynamically crafts narratives that evolve based on player choices, offering an interactive exploration of gender issues. Through a comparative analysis of AI-generated outcomes and original stories, players can reflect on the impact of their decisions. The paper thoroughly examines the game’s structure, mechanics, and character portrayals, analyzing its potential to foster progressive gender concepts.

Drawing on the story of Mei Sanniang as an example [29], the paper illustrates the game’s capacity to develop a nuanced

understanding of gender concepts to prove how effective generative AI is in enhancing narrative interactivity for cognitive education on gender issues. Players influence the narrative and the fate of characters by responding to gender-related prompts. The generative AI system produces diverse outcomes and visualizations based on these responses, enriching the story’s variability. Our research introduces a novel approach to achieving diversity in results through big data analysis, providing timely feedback that informs player learning. It rigorously analyzes the integration of generative AI with folklore narratives for personalized learning experiences, offering insights into the application of emerging technologies for engaging educational games on sensitive subjects.

Background, Motivation and Related Works



(a) BinaryX and AiGC Labs, First AI-Powered VR Game

(b) Alibaba Digital Media Group Debuts First Virtual Idol

Figure 1: The Successful AIGC Game and AIGC Idol in the World. ©Credit by Business Wire and Alibaba.

Our project “Liaozhai in the Mirror” is a serious game designed to foster a proper understanding of gender issues among students through an engaging and interactive learning experience. This game immerses players in a world inspired by the classic Chinese folklore from the “Liaozhai Zhiyi” collection. Within this realm, players take on roles that challenge gender discrimination biases and promote the exploration of identity. The game presents players with decisions, each leading to various story outcomes generated by AI—a technology already proven successful in numerous commercial entertainment applications (see Figure 1). This design encourages players to think critically about gender topics by comparing multiple narrative possibilities. For instance, the game addresses the issue of gaslighting by drawing on its source story, “Skin Painting,” and reflecting on the psychological manipulation that victims may endure.

Overview of Using Serious Games as the Educational Medium

Serious games, distinct from their entertainment-focused counterparts, are intricately designed with educational objectives as the priority [24]. They are powerful knowledge transfer tools and crucial in diverse fields such as medical, cultural, environmental, and skills education [5, 20, 32, 22, 3]. Empirical evidence supports the consensus within the academic community about the effectiveness of serious game-assisted learning. These games enhance general knowledge and cognitive aptitude and foster a positive attitude toward education [16]. Actively engaging players, serious games strategically incorporate surprising elements to stimulate cognitive structures, thereby endowing students with valuable proportional reasoning skills [35]. At critical stages of cognitive development, these skills contribute to a more comprehensive knowledge framework and facilitate deeper learning. A comprehensive study involving 24 groups and 108 students validates the enhanced effectiveness of serious games and gamification in sexual health courses. Compared to traditional teaching methods, integrating game elements such as leaderboards, point systems, competition, badges, levels, and immediate feedback has proven to be the most effective strategy, resulting in improved outcomes [11]. This highlights the significant impact of gamification in serious games on advancing gender awareness education.

Gender Education for Students

Adolescence is a critical phase in shaping gender perceptions, aligning with Erikson's theory of self-development, where individuals aged 12-18 grapple with identity formation and strive to avoid role confusion [7]. During this period, social cues—particularly those that occur alongside the development of secondary sexual characteristics—significantly impact gender awareness, shaped by societal reactions to these phenomena [17].

However, a systematic paradigm for gender perception education is lacking. Adolescents often rely on family education, popular science books, internet content, and life experiences to construct their gender cognition. Traditional stereotypes persist, especially in costumes for children's festivals [23]. Trust in family and adherence to traditional roles can lead to stereotypical behaviors, particularly among girls [17]. Peer attitudes also have a significant influence on behavior and mental health [1], leading to a complex challenge for adolescents as they strive to understand themselves and their gender perception, which can result in conflicts. Boys, in their quest to construct masculinity, may engage in misbehavior more frequently [12]. Adolescent females often encounter sexual harassment and face sexism in academic and sports settings [18]. The absence of comprehensive gender education promotes conformity to traditional stereotypes, with girls sometimes downplaying intelligence to maintain attractiveness [33]. Our game utilizes serious games to assist in the development of correct gender consciousness, enabling active engagement and a nuanced understanding of gender issues from multiple perspectives.

Purpose of Exploring “Liaozhai in the Mirror”

Players critically engage with AI-driven narratives, gaining insights into the real-life consequences of multifaceted gender issues. This interactive experience encourages them to empathize with and understand gender bias by stepping into the characters' shoes within the game.

- **Narrative Relevance** The game's narrative delves into gender discrimination and identity through character-driven quests, fostering comprehensive exploration within a strategic narrative layering structure. Illustrated by Judge Lu's story, players learn about bystander responsibilities in gender conflicts. In this narrative, Judge Lu, the Underworld's Overseer, yields to Zhuerdan's request, which results in tragic consequences due to Zhuerdan's greed. This highlights the importance of a correct understanding of gender roles, even in the absence of an intimate relationship. Mei Sanniang's story encourages players to recognize and address emotional abuse from a female perspective. It depicts vulnerability to Wang Anxu's manipulation and the ensuing cognitive dissonance. Despite adversity, Mei Sanniang confronts ongoing psychological manipulation in the afterlife, mirroring real-world scenarios of abuse denial and victim disorientation. By proposing to repay kindness, Xiao Cui personifies the free will of modern women, maintaining an open-minded and independent personality. The narrative progression strategically guides players from understanding the “what” to the “why,” and ultimately to the “how” of gender issues.
 - **Mechanical Relevance** Our game mechanics are meticulously designed to engage players deeply with gender issues. By categorizing issues into dating relationships, bystanders, gaslighting, dating violence, gender equality, women's empowerment, and consent, the game allows players to experience a diversity of character personalities. Comparing two versions of a story encourages reflection on gender values, fostering a profound understanding and emphasizing the importance of personal independence. The game effectively utilizes its platform to highlight gender awareness, decision-making, and the exploration of gender dynamics.
 - **Cultural Relevance** Rooted in Chinese folklore, this game offers a cultural lens for examining gender issues, transcending cultural boundaries, and emphasizing their universal resonance. It prompts players to contemplate identity within a broader social and cultural framework. By intertwining gender dynamics with traditional Chinese narratives, the game provides a fresh perspective. It highlights the universal challenges associated with gender and showcases the potential of video games for cultural exchange and understanding. Players are immersed in the vibrant world of Chinese stories, fostering an appreciation for Chinese literature.
- Pu Songling's “Strange Stories from a Chinese Studio (Liaozhai Zhiyi),” a novel from the Qing Dynasty, gave an exceptional representation of the gender issues of its era. This work has been revived through both film and television adaptations. For instance, “A Chinese Ghost

Story,” embodying a Liaozhai Zhiyi narrative, earned a spot among the Hong Kong Film Awards Association’s “Best 100 Chinese Motion Pictures ¹.” “Skin Painting,” another Liaozhai story, was adapted into highly successful films in 2008 ² and 2012 ³.

Conceptual Framework

The conceptual framework for this paper draws on several key areas of theory and research: Serious Games, Gender Education, and AIGC. Serious games refer to games designed for purposes beyond mere entertainment. These games aim to educate, train, and inform, often by simulating real-world scenarios. Serious games have been used in various fields, such as healthcare, military, business, and education, providing an engaging medium for learning and skill development [21]. In education, serious games have been found to foster motivation, cognitive engagement, and deep learning [10]. Gender education focuses on teaching students about gender roles, identities, and relations. It seeks to promote gender equality and challenge stereotypes. In recent years, serious games have been used as a tool for gender education [9]. For example, Kafai, Richard, and Tynes [15] discussed how games can introduce complex gender-related topics and foster critical thinking about gender issues. The emergence of AI has brought a transformation in game design and development. AI has generated content, created responsive game characters, and adapted games to individual players [31]. Generative AI, in particular, has been used to create varied and complex game narratives, enhancing the player’s immersion and engagement [36]. This paper examines the application of serious games for gender education, particularly through the lens of “Liaozhai in the Mirror.” It highlights the game’s innovative use of Chinese literature and generative AI to address and reshape understanding of gender issues, contributing to the broader discourse on game-based learning. Gleaning from the aforementioned literature and technology application papers, we understand that AI harbors the potential to broaden and enhance the freedom of narrative interactivity significantly. Furthermore, serious games are an effective medium for communicating gender concepts.

Creative Design Process

The game’s creative design process encompassed concept development, character design, visual design, narrative storytelling, and game mechanics. Paper prototypes were employed during concept development to explore various storylines, characters, scenarios, and potential AI-generated narratives, delineating the game’s scope. The significance of AI-driven narratives, which adapt based on player responses and facilitate comparing results with original stories to enhance decision-making, was underscored. Character design was informed by textual descriptions and visual depictions, resulting in illustrations that integrate seamlessly with the game world. Game mechanics were ingeniously crafted to impart

gender knowledge through gameplay in an engaging format, combining RPG elements with quizzes interwoven with storylines, characters, and a knowledge graph.

Concept

During the concept development phase for the game, paper prototypes were used to outline various storylines, characters, scenarios, and potential AI-generated narratives based on players’ responses, deemed right or wrong. These prototypes became foundational in understanding the original stories of “Liaozhai in the Mirror,” offering a basis for brainstorming and blending different narrative interpretation possibilities. This tangible concept exploration with paper prototypes allowed game designers to visualize various narrative outcomes with characters and interactive responses from players, leading to a more comprehensive understanding of the game’s panorama [27].

The AI generates narrative results based on player responses, highlighting the consequences and challenges that characters will face due to their choices, whether deemed right or wrong [25]. This feature allows players to compare their outcomes with the original story in “Liaozhai Zhiyi,” enhancing their decision-making process, particularly regarding gender topics awareness and responses within the game. The extensive range of potential storylines made possible through the AI’s generative capabilities goes beyond the limits of a predefined digital narrative. This allows players to explore and shape their own narratives, making AI-generated storytelling compelling and encouraging repeated engagement and learning—especially for female players. This feature instills a mindset recognizing the lasting impact of unrecognized gender issues during adolescence, motivating players to apply critical thinking to real-life decisions. The game design incorporates distinct stages of gameplay and feedback, providing players with comprehensive knowledge to assess their progress while completing tasks. Critiques of responses at each game level offer immediate cause-and-effect feedback, enabling players to adjust their reflections promptly. Furthermore, the desire for narrative control extends to the players’ characters themselves [2].

Character Design

The visual representation of character design draws inspiration from the rich tapestry of existing textual descriptions and visual portrayals. Our design process meticulously considered the character nuances as depicted by Pu Songling, representations in existing illustrated storybooks [13], and character portrayals in various film and TV adaptations [8]. Using Photoshop, we crafted illustrations of Bai Yang, Lu Pan, Mei Sanniang, Wang Anxu, Nie Xiaoqian, Xiao Cui, and Xiao Xie that integrate seamlessly into the game’s world, maintaining authenticity while enhancing aesthetics (see Figure 2).

Visual Design

Our visual design for the game is bifurcated: one aspect focuses on the character design and their backgrounds, while the other revolves around AI-generated scenarios based on the player’s task responses. Drawing parallels with the animated film “The Breadwinner,” we’ve adopted a dual-artistic

¹<https://www.imdb.com/list/ls058302162/>

²<https://www.boxofficemojo.com/year/2008/?area=CN>

³<https://www.screendaily.com/china-box-office-round-up-2012-china-becomes-worlds-second-biggest-market/5050843.article>



Figure 2: The Character Design of Seven People in LiaoZhai. ©Credit by Authors.

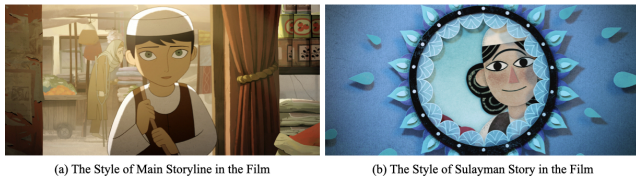


Figure 3: The Style of Two Parallels Visual Storytelling in the Film. ©Credit by Breadwinner.

style. Through two distinct artistic techniques, this film brilliantly portrays a young girl’s reality juxtaposed against her imaginative world. The girl’s personal fictional “Story of Sulayman” is rendered in a decorative animation space created through paper cut-out techniques (see Figure 3a). Her real world is portrayed in a more realistic, three-dimensional space using perspective techniques (see Figure 3b). In our game, the original story of the “LiaoZhai Zhiyi” setting takes inspiration from traditional Chinese gong bi (fine-brush) artwork, paying homage to the refined techniques and intricate craftsmanship inherent in this ancient style as the backdrop for the characters. The figures are designed using a linear artistic illustration style to delineate the appearances and characteristics of the different characters in LiaoZhai. These choices encapsulate the depth and richness of traditional Chinese aesthetics and modern figure illustration (see Figure 4).

Conversely, we’ve embraced a long scroll style with tiny figures and expansive scenes for AI-generated fictitious scenarios, reflecting a meticulous, realistic painting style. These scenarios are dynamically generated in real-time, offering a stark yet harmonious contrast to the traditional aesthetic (see Figure 5).

Narrative Storytelling

This paper examines seven characters from “LiaoZhai Zhiyi”, shedding light on inherent gender cognition contradictions. It establishes links between gender cognition questions and plot elements, reshaping the narrative to fuse with gender cognition knowledge for enhanced player engagement.

- **Traditional Storyline as the Initial Version**



Figure 4: The Visual Structure Design of LiaoZhai in the Mirror, Shows the Linear Illustration Style. ©Credit by Authors.



Figure 5: The AI-Generated Visual Images have a Ratio of 25 by 7 in the Long Scroll Style. ©Credit by Authors.

The tale of Nie Xiaoqian corresponds to the game’s knowledge base of gender equality. Nie Xiaoqian’s unsuccessful attempt to use her beauty for personal gain underscores the narrative’s focus on the pitfalls of relying on appearance for social advantages. These stories encourage players to recognize the importance of true character and the capacity for independent living as pathways for women to attain a better life. In contrast, Xiao Cui’s story corresponds to exploring female empowerment. As a fox spirit challenging traditional norms, Xiao Cui actively maneuvers through conflicts between the powerful and wealthy while maintaining an open-minded and independent personality. This narrative challenges traditional stereotypes, highlighting the agency of modern women. Xiao Xie’s story aligns with the theme of consent in gender relations. Confronted with the advances of the eunuch Tao Sheng, Xiao Xie must navigate the choice regarding the appropriateness of entering into a relationship.

- **Generated Storyline by AI as the Comparable Version**

During the narrative progression, players direct the AI to leverage the Large Language Model (LLM) GPT-4 capabilities and the graphic model Midjourney for concurrent image and text generation by selecting specific questions. Upon completing the questions, the game interface reveals the story screen, concluding scenes, and question analysis associated with diverse endings crafted by the AI based on critical information from different story trajectories. Notably, the plot directions for the story endings are not predetermined by developers; instead, they represent dynamically generated content by AI in real-time. Consequently, even with identical player choices, the AI-produced story content remains inherently diverse. Integrating AI in this

game study enriches the player's experience by introducing novel and unpredictable elements. To ensure coherence in the generated content, we have input the knowledge base of the "Liaozhai Zhiyi" storyline into the model. Additionally, we defined the cognitive framework for an independent woman within the model by utilizing provided information and descriptions, enabling the model to generate story content and answer analyses from this perspective. Based on the previous story and the players' responses, the new story provides results that allow players to realize how incorrect awareness affects the final outcomes. The example of Mei Sanniang, as shown in this paper (see Figure 8), provides an unfavorable ending after a series of incorrect responses by a tester.

- **Narrative Relevance, Effect, and Feedback**

In summary, the narrative storylines of the seven characters in the novel "Strange Tales from a Chinese Studio" are deeply associated with the seven major gender issues we aim to address. Bai Yang's story is linked to dating relationships; Lu Pan's to the role of bystanders; Mei Sanniang's to gaslighting; Wang Anxu's to dating violence; Nie Xiaoqian's to gender equality; Xiao Cui's to women's empowerment; and Xiao Xie's to the concept of consent. Players' understanding of the respective gender issues during the quiz process is important for assessing the characters' cognitive abilities in generating new AI-driven narrative storylines (see Figure 6b).

The stark contrast between the newly generated narratives and the traditional storylines provides immediate feedback on the players' grasp of knowledge regarding these gender issues. Players can change the characters' destinies by applying their knowledge and gaining an understanding, discernment, and strategies to navigate these seven gender issues. Through engaging with the game, we hope that players can apply the knowledge acquired in this serious game to positively influence their own destinies in real life.

Game Mechanics

The core game mechanics combine Role-Playing Game (RPG) elements with quiz-based functions. An RPG is a genre of electronic games where players assume the roles of and control one or more virtual characters. Players progress through the game by exploring the virtual world, completing quests, interacting with other virtual characters, and developing the attributes and skills of their own characters [26]. Numerous successful serious games have integrated RPG mechanics with structured knowledge, positively impacting student engagement and knowledge acquisition [14].

In the game design process, several factors were considered. These include a knowledge graph on gender issues, the immersive experience of role-playing games, the open-mindedness fostered by AI-driven narratives, and the timely feedback and positive reinforcement that quiz results provide. This section describes the basic implementation of each module (see Figure 6a).

- **Storylines on Gender Issues** Upon entering the game homepage, players will encounter seven characters from the "Liaozhai in the Mirror" universe, each with their

traditional storyline. We have carefully matched these characters with seven common gender-related themes that teenagers frequently encounter, including dating relationships, bystanders' roles, gaslighting, dating violence, gender equality, women's empowerment, and consent. These themes are intricately linked to the storylines of the seven characters in the game.

Due to the lack of systematic gender education, teenagers often struggle to understand and define gender-related issues when they encounter them. To address this, we have organized these issues into gender-related question sets. Both male and female players can select different characters to learn about various aspects of gender-related knowledge. By expanding the understanding of gender issues through engaging narrative gameplay, the game aims to empower teenagers with the knowledge and skills necessary to navigate and address the gender-related challenges they may encounter.

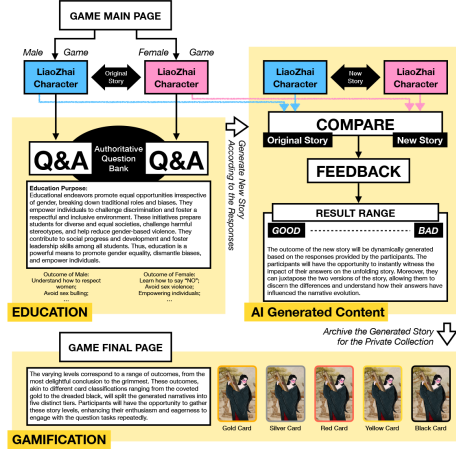
- **Games and Learning Tasks** After selecting a character, the game interface will present the traditional storyline of that character within the "Liaozhai in the Mirror" universe. For instance, let's consider the story of Mei Sanniang, which aligns with the theme of gaslighting.

Gaslighting refers to emotional abuse and manipulation that causes the victim to question their sanity, leading to a loss of self-esteem, development of self-doubt, and a gradual feeling of entrapment [30]. In the game's universe, Mei Sanniang's story portrays her tragic end due to gaslighting by her lover. Even in death, as a ghost, she remains ensnared by the deceitful manipulation.

Within Mei Sanniang's storyline, players must demonstrate their understanding, recognition, and strategies to counteract gaslighting by answering questions. If players engage with the character's narrative and challenges, they may accept the tasks and proceed to the quiz section. If not, they can return to the homepage to explore other character storylines. This strong correlation between gender issue themes and the knowledge points that players need to acquire is consistent throughout the game's narrative. The objective of the task is made clear at the beginning of the game.

- **Authoritative Question Bank** Once players enter the quiz section, they will be presented with a set of gender-related questions specifically tailored to the storyline of the chosen character. We have compiled and organized key knowledge points related to women's issues from representative feminist works spanning the 19th to 21st centuries, such as "Against Our Will: Men, Women, and Rape" [4] and "Are Women Human? And Other International Dialogues" [19]. These knowledge points have been transformed into an authoritative question bank focusing on themes such as dating relationships, the role of bystanders, gaslighting, dating violence, gender equality, women's empowerment, and consent.

Each theme consists of three tasks, with a total of fifteen questions. The format for the questions is multiple-choice, with three options for each. For example, all fifteen questions in the Mei Sanniang storyline are related to the theme



Liaozhai Characters	Topic Covered	3 Tasks 15 Questions	Results
Bai Yang	Dating Relationships	Each has 3 Options	$3^{15} = 14,348,907$
Lu Pan	Bystanders	Each has 3 Options	$3^{15} = 14,348,907$
Mei Sanniang	Gaslighting	Each has 3 Options	$3^{15} = 14,348,907$
Wang Anxu	Dating Violence	Each has 3 Options	$3^{15} = 14,348,907$
Nie Xiaoqian	Gender Equality	Each has 3 Options	$3^{15} = 14,348,907$
Xiao Cui	Women Empower	Each has 3 Options	$3^{15} = 14,348,907$
Xiao Xie	Consent	Each has 3 Options	$3^{15} = 14,348,907$

Figure 6: (a) The Workflow of Liaozhai in the Mirror. (b) The Relationship of Characters and Topic Covered. ©The Authors.

of gaslighting. Consequently, there are a total of three to the power of fifteen (or 14,348,907) possible combinations of answers for Mei Sanniang’s storyline alone. These combinations are then input into the AI system to generate different storylines.

• AI-driven Narratives

The game utilizes the AI big language model GPT-4 and the AI image generation model Midjourney. The AI transcends its traditional role of merely summarizing data and interpreting text, creating novel stories and image outcomes. It is essential to emphasize that the primary objective of the AI generation mechanism within this game is not to resolve gender-related challenges but to assist players in recognizing and understanding these issues. The AI serves as a tool to prompt players to identify problems, offering constructive or critical feedback based on the stories and images generated from their responses. It is crucial to acknowledge that the role of AI generation in serious games is that of a “supporter” rather than a “solver” within the game mechanics [28, 37]. Players playing “Liaozhai in the Mirror” will experience the innovative application of AI technology in the New Storylines section. This technology utilizes AI systems to generate entirely new storylines for the character based on the players’ responses during the quiz section. Specifically, the player’s answers to questions related to the theme of gaslighting will influence the development of Mei Sanniang’s story.

Each player’s answer is considered as input data for analysis and processing by the AI system. The AI determines the gaslighting Mei Sanniang experiences from her lover in the new storyline based on the player’s responses to gaslighting questions. This means the player’s choices and answers directly impact the character’s experiences and fate, creating a unique story development path. GPT-4 and Midjourney will process 14,348,907 combinations to craft unique narratives and visuals for “Liaozhai in the Mirror,” which features seven characters with varying storylines. The game will produce many endings from 100,442,349 possi-

ble player responses, with AI storylines diversifying even for identical answers. Players will see real-time effects of their choices on the unfolding story and can contrast these with original story versions to grasp the influence of their decisions on the narrative.

- **Timely Feedback and Evaluation** The timely feedback mechanism in serious games significantly impacts the consolidation of knowledge points. This impact manifests in improving learning efficiency and positively stimulating players’ interest in learning. For example, in our game, the feedback section of the Mei Sanniang storyline not only analyzes players’ answers to the gaslighting question set to reinforce knowledge points and provides a detailed explanation of the history of gaslighting, its definition, and strategies for avoiding such issues. Incorporating the feedback mechanism in the game raises awareness of the concept and promotes informed decision-making.

As a reward mechanism in the game, the character card system rewards players with character cards of different colors and levels based on their performance in answering questions. The varying levels correspond to outcomes ranging from the most delightful conclusion to the grimmest. By collecting cards of varying levels, players can gauge their proficiency in different knowledge areas, enabling them to identify areas that require further attention and tailor their learning accordingly. In the final part of the game process, we would like to gather player feedback through a questionnaire on this game’s educational aspects, recommendations, and knowledge acquisition.

Technical Implementation

This section outlines the challenges faced and the technical implementation of game realizations, encompassing the target platform, text and image generation, the pilot testing process, and game testing and iteration.

Target Platform

Our game is designed to operate on network terminals such as PCs and Macs. We selected this platform to facilitate accessibility via Discord, allowing universal participation regardless of geographical constraints. This platform choice posed specific challenges, including ensuring cross-platform compatibility and optimizing performance for various operating systems. The online nature of the platform also allowed us to receive timely responses, which were then processed by GPT-4 for text generation and by Midjourney (available on Discord) for image generation. It also enabled us to collect and analyze gameplay data efficiently, facilitating rapid iterations and enhancements to the game.

Generation

The generation of game results is a multi-faceted process involving text and image creation according to the players' responses (see Figure 7).

For text generation, we utilized GPT-4. This state-of-the-art language model enables us to create diverse and contextually relevant storylines that resonate with the original narrative and players' responses, enhancing the game's overall narrative experience. However, employing such a sophisticated AI model presented challenges. It was crucial to train and fine-tune the model to ensure that the generated text balanced creativity and coherence while aligning with the game's thematic and tonal requirements. To overcome these challenges, we introduced a preface in the game that details the historical setting of the original story, encompassing the era, architectural styles, characters, and traditional ancient Chinese elements. This preface provides the necessary context to the AI, steering the text generation away from anachronistic or overly modern content. While GPT-4 does not inherently understand historical context, our design choices and tailored model training ensure that the AI generates content that remains authentic and consistent with the setting of Pu Songling's *Liaozhai Zhiyi* for the original version.

Regarding image generation, we reminded Midjourney (available on Discord) to produce images that complement the gameplay data in real-time, thereby enabling rapid iteration and enhancement of the game. This immediate image generation is pivotal in enhancing the game's visual appeal and enriching the players' experience. We devised specific prompts for image generation to ensure that the generated images adhere to the context and aesthetic requirements while maintaining a consistent visual style. These include controlling the aspect ratio of images with commands like “-ar 25:7” and using the “-seed value” to keep all images consistent in style and method.

Pilot Testing Process

We conducted thorough pilot testing before releasing the game to the wider public. This phase was a critical component of our development cycle, enabling us to validate game mechanics, evaluate the narrative's relevance and enjoyability, and ensure the seamless functionality of our AI-driven text and image generation systems. The pilot testing involved a select group of four students (two females and two males)

chosen for their diverse gaming experiences, which provided a wide range of perspectives. They were encouraged to explore various game outcomes by entering random responses to test the AI's capability to generate different endings. Additionally, they challenged the AI with diverse inputs and interacted with the game in as many ways as possible to assess its responsiveness and versatility thoroughly.

Game Testing and Iteration

The development of our game was an iterative process, with game testing as a crucial component of the cycle. This continuous cycle of testing, feedback collection, and game refinement was essential for improving the game's quality and ensuring an engaging experience for players. Our game-testing strategy encompassed multiple phases. Initially, the game underwent in-house testing by our development team, allowing us to identify and resolve any immediate issues or bugs that could disrupt gameplay. Subsequently, we plan to broaden our testing to include a select group of external testers during the pilot testing phase. We will gather feedback through structured surveys and open-ended discussions to comprehensively understand the player experience, enabling us to make informed iterative improvements to the game. Additionally, we have paid close attention to the game's performance on the Discord platform, implementing necessary optimizations to ensure smooth gameplay.

Evaluation Method

To assess the impact of our game on players' understanding and education regarding gender issues, we designed a method for evaluating game testing. We will recruit diverse players aged 14-18 from schools, communities, and online platforms. During game testing, players will engage with the game's prompts and objectives, which cover a variety of gender-related themes and narratives.

Data collection will employ both quantitative and qualitative methods. Quantitative data will include game scores, the accuracy of answers, and response times. Qualitative data will encompass observations, game feedback, and surveys. We plan to evaluate the impact based on criteria such as gender awareness, learning outcomes, and ideological transformation. Gender awareness will be assessed through the correctness of answers, accuracy rates, and players' descriptions of their understanding and perceptions of gender issues. Improvements in-game scores will evaluate learning outcomes and knowledge acquisition, the accuracy of answers, and players' descriptions of changes in understanding and knowledge application. Ideological transformation will be assessed through questionnaire surveys and the analysis of observational records, focusing on changes in attitudes and ideological shifts.

Finally, we will discuss the results of the evaluation indicators to identify the game's strengths and limitations and to explore future research directions, aiming to uncover further possibilities.

Discussions

Our inaugural publication, “*Liaozhai in the Mirror*,” is an educational tool to illuminate gender-related issues. We antici-

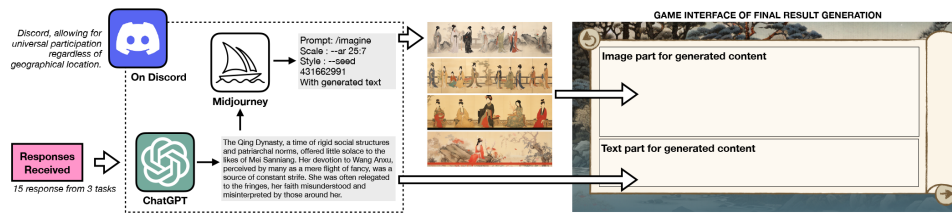


Figure 7: The Generation Process of “Liaozhai in the Mirror”. ©Credit by Authors.

pate several challenges throughout this journey, including potential resistance or misconceptions from male audiences, often rooted in gender stereotypes and biases. There is also the risk of facing opposition for engaging with controversial topics. Furthermore, our endeavor unfolds within the broader context of educational gaming, specifically the use of serious games for educational purposes, which frequently sparks debates over their effectiveness and suitability.

The cultural sensitivity of our work, such as the varying degrees of acceptance across different regions and diverse cultural backgrounds, is a critical factor. To navigate this, we will implement stringent content development and testing methodologies. Our approach will also encompass extensive research into cultural norms and values, consultation with experts, and integration of various perspectives during the concept development stage.

Potential Challenges

We anticipate encountering resistance from some male individuals. This challenge is likely due to deeply ingrained gender stereotypes and biases, as well as possible misunderstandings regarding the intent and importance of education on gender issues. Given the subject’s sensitive nature, the application might become a focal point for criticism or controversy, especially from those who dispute its methodology or goals. Concurrently, the role and efficacy of serious games in educational settings are subjects of an ongoing debate, which may affect the reception and utilization of our application.

Mitigation Strategies

Fostering an open dialogue around gender issues is essential in addressing resistance from male perspectives. By presenting clear and factual information, misunderstandings and stereotypes can be dispelled. This highlights the necessity to destigmatize the discussion of gender issues and to demonstrate that it is not exclusively a “female” concern but a societal one. To mitigate the risk of controversy, “Liaozhai in the Mirror” could feature a broader representation of male characters to express varied male viewpoints on gender matters and to balance the game’s content, which is also a target for our next steps. This approach could encourage male players to empathize with different characters’ experiences and reflect on their attitudes and behaviors. However, the key to overcoming skepticism about the efficacy of serious games in educational contexts lies in adopting an evidence-based approach, which necessitates societal involvement. Disseminating the findings of this research to educators, parents, and

other stakeholders could foster broader support for the application’s use in educational settings.

Upcoming Plan

To evaluate the educational impact of “Liaozhai in the Mirror,” we have devised a comprehensive plan for data collection. Before game testing begins, we will survey players to gauge their initial awareness, attitudes, and ideologies regarding gender issues. This survey will address gender equality, stereotypes, and discrimination to establish a baseline. During game testing, players will engage in gameplay based on specific prompts and objectives. We will record quantitative data, such as scores, accuracy, and response times. Following the game, a post-test survey will measure changes in players’ awareness, attitudes, and ideologies concerning gender issues. This survey will provide insights into the players’ attitudes after playing the game. Additionally, we will collect qualitative data by observing players’ behavior and responses during game testing, which will help us understand cognitive processes and any shifts in attitudes. Follow-up interviews with selected players will offer deeper insights into their gaming experiences, their comprehension of gender issues, and how they apply their new knowledge.

Conclusion and Future Works

“Liaozhai in the Mirror” is a pioneering endeavor at the intersection of serious gaming, gender education, and AIGC, offering a substantial academic platform for examining gender issues. The game deftly weaves diverse, AI-generated storylines to create an interactive space where players can explore and understand gender-related subjects. Researchers can scrutinize the game’s narratives, character portrayals, and gameplay mechanics, yielding insights into gender representation and discourse within this interactive medium. Such academic inquiry feeds into wider conversations on gender, gaming, and the capacity of serious games to raise social awareness.

While our work on “Liaozhai in the Mirror” is innovative, we recognize areas for enhancement. Acknowledging that the open-ended nature of AI-generated content in the game introduces unpredictability concerning content quality is crucial. Future research will focus on refining ways to train AI models iteratively to serve the game’s needs better and prevent the generation of low-quality content [6]. Identifying these challenges enables us to formulate strategies to mitigate risks, ensuring smooth game development and a positive player experience. The release represents merely the first step

in a continuous process of refinement and expansion, with regular updates informed by player feedback and technological progress.

Given the challenges of cross-platform compatibility on PCs and Macs, we aim to extend the game's accessibility to mobile devices in version 2.0, broadening our audience and amplifying our educational impact. Training AI to act as a storyteller using generative video will enhance the immersive nature of the game. Ensuring consistency in AI-generated text and imagery, particularly with the planned expansion of character rosters, will be achieved through meticulous dataset curation and ongoing model fine-tuning guided by player input.

In our pursuit of innovation, future iterations of "Liaozhai in the Mirror" will probe more deeply into specific gender themes, enrich character profiles, and embed more comprehensive educational content. Through these endeavors, we aspire to craft an engaging and meaningful educational experience, contributing to the scholarly dialogue and promoting a wider understanding and recognition of gender issues.

References

- [1] Abele, A. E.; Ellemers, N.; Fiske, S. T.; Koch, A.; and Yzerbyt, V. 2021. Navigating the social world: Toward an integrated framework for evaluating self, individuals, and groups. *Psychological Review* 128(2):290.
- [2] Alamri, A.; Hassan, M. M.; Hossain, M. A.; Al-Qurishi, M.; Aldukhayyil, Y.; and Hossain, M. S. 2014. Evaluating the impact of a cloud-based serious game on obese people. *Computers in Human Behavior* 30:468–475.
- [3] Ashraf, H.; Motlagh, F. G.; and Salami, M. 2014. The impact of online games on learning english vocabulary by iranian (low-intermediate) efl learners. *Procedia-Social and Behavioral Sciences* 98:286–291.
- [4] Brownmiller, S. 1993. *Against our will: Men, women, and rape*. Ballantine Books.
- [5] Cheng, M.-T., and Annetta, L. 2012. Students' learning outcomes and learning experiences through playing a serious educational game. *Journal of Biological Education* 46(4):203–213.
- [6] Cook, M. 2023. Infinity is trash (and that's okay).
- [7] Côté, J. E. 2009. Identity formation and self-development in adolescence. *Handbook of adolescent psychology* 1(3):266–304.
- [8] (Director), W. J. 2005. Strange tales of liao zhai. TV Series. Accessed on 2023-11-19.
- [9] Everett, A.; Soderman, B.; deWinter, J.; Kocurek, C.; Huntemann, N. B.; Trepanier-Jobin, G.; Chien, I.; Murray, S.; Hutchinson, R.; Patti, L.; et al. 2017. *Gaming representation: Race, gender, and sexuality in video games*. Indiana University Press.
- [10] Hainey, T.; Connolly, T. M.; Boyle, E. A.; Wilson, A.; and Razak, A. 2016. A systematic literature review of games-based learning empirical evidence in primary education. *Computers & Education* 102:202–223.
- [11] Haruna, H.; Zainuddin, Z.; Okoye, K.; Mellecker, R. R.; Hu, X.; Chu, S. K. W.; and Hosseini, S. 2023. Improving instruction and sexual health literacy with serious games and gamification interventions: an outlook to students' learning outcomes and gender differences. *Interactive Learning Environments* 31(4):2392–2410.
- [12] Heyder, A.; Van Hek, M.; and Van Houtte, M. 2021. When gender stereotypes get male adolescents into trouble: A longitudinal study on gender conformity pressure as a predictor of school misconduct. *Sex roles* 84:61–75.
- [13] Hoh, A. 2018. The strange tales from liaozhai. 4 Corners of the World. Library of Congress. Accessed on 2023-11-19.
- [14] Irkinovich, N. R. 2022. The importance of role-playing game in teaching english in a non-linguistic university. *International Journal of Pedagogics* 2(09):29–32.
- [15] Kafai, Y. B.; Richard, G. T.; and Tynes, B. M. 2016. *Diversifying Barbie and Mortal Kombat: Intersectional perspectives and inclusive designs in gaming*. Lulu. com.
- [16] Lamb, R. L.; Annetta, L.; Firestone, J.; and Etopio, E. 2018. A meta-analysis with examination of moderators of student cognition, affect, and learning outcomes while using serious educational games, serious games, and simulations. *Computers in Human Behavior* 80:158–167.
- [17] Lamer, S. A.; Dvorak, P.; Biddle, A. M.; Pauker, K.; and Weisbuch, M. 2022. The transmission of gender stereotypes through televised patterns of nonverbal bias. *Journal of Personality and Social Psychology*.
- [18] Leaper, C., and Brown, C. S. 2008. Perceived experiences with sexism among adolescent girls. *Child development* 79(3):685–704.
- [19] MacKinnon, C. A. 2007. *Are women human?* Harvard University Press.
- [20] Mason, L.; Gerling, K.; Dickinson, P.; Holopainen, J.; Jacobs, L.; and Hicks, K. 2022. Including the experiences of physically disabled players in mainstream guidelines for movement-based games. In *Proceedings of the 2022 CHI Conference on Human Factors in Computing Systems*, 1–15.
- [21] Michael, D. R., and Chen, S. L. 2005. *Serious games: Games that educate, train, and inform*. Muska & Lipman/Premier-Trade.
- [22] Morganti, L.; Pallavicini, F.; Cadel, E.; Candelieri, A.; Archetti, F.; and Mantovani, F. 2017. Gaming for earth: Serious games and gamification to engage consumers in pro-environmental behaviours for energy efficiency. *Energy Research & Social Science* 29:95–102.
- [23] Murnen, S. K.; Greenfield, C.; Younger, A.; and Boyd, H. 2016. Boys act and girls appear: A content analysis of gender stereotypes associated with characters in children's popular culture. *Sex roles* 74:78–91.
- [24] Nazry, N. N. M., and Romano, D. M. 2017. Mood and learning in navigation-based serious games. *Computers in Human Behavior* 73:596–604.

- [25] Ravyse, W. S.; Seugnet Blignaut, A.; Leendertz, V.; and Woolner, A. 2017. Success factors for serious games to enhance learning: a systematic review. *Virtual Reality* 21:31–58.
- [26] Rollings, A., and Adams, E. 2003. *Andrew Rollings and Ernest Adams on game design*. New Riders.
- [27] Schell, J. 2008. *The Art of Game Design: A book of lenses*. CRC press.
- [28] Seeber, I.; Bittner, E.; Briggs, R. O.; De Vreede, T.; De Vreede, G.-J.; Elkins, A.; Maier, R.; Merz, A. B.; Oeste-Reiß, S.; Randrup, N.; et al. 2020. Machines as teammates: A research agenda on ai in team collaboration. *Information & management* 57(2):103174.
- [29] Songling, P. 2006. *Strange tales from a Chinese studio*. Penguin UK.
- [30] Stern, R. 2018. *The gaslight effect: How to spot and survive the hidden manipulation others use to control your life*. Harmony.
- [31] Summerville, A.; Snodgrass, S.; Guzdial, M.; Holmgård, C.; Hoover, A. K.; Isaksen, A.; Nealen, A.; and Togelius, J. 2018. Procedural content generation via machine learning (pcgml). *IEEE Transactions on Games* 10(3):257–270.
- [32] Tencent. 2023. Five tencent businesses announce pan-entertainment upgrades to neo-culture creativity. Accessed: 2023-11-18.
- [33] Tiedemann, J. 2000. Parents’ gender stereotypes and teachers’ beliefs as predictors of children’s concept of their mathematical ability in elementary school. *Journal of Educational psychology* 92(1):144.
- [34] Williams, D.; Martins, N.; Consalvo, M.; and Ivory, J. D. 2009. The virtual census: Representations of gender, race and age in video games. *New media & society* 11(5):815–834.
- [35] Wouters, P.; van Oostendorp, H.; ter Vrugte, J.; Vandercruysse, S.; de Jong, T.; and Elen, J. 2017. The effect of surprising events in a serious game on learning mathematics. *British journal of educational technology* 48(3):860–877.
- [36] Yannakakis, G. N., and Togelius, J. 2018. *Artificial intelligence and games*, volume 2. Springer.
- [37] Zhou, Y.; Koyama, Y.; Goto, M.; and Igarashi, T. 2020. Generative melody composition with human-in-the-loop bayesian optimization. *arXiv preprint arXiv:2010.03190*.

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Mengyao Guo is an award-winning Artist, Illustrator, and Graphic Designer based in Shenzhen and Macau. She is an assistant professor at Shenzhen International School of Design and Harbin Institute of Technology and a Ph.D. candidate in visual communication at the University of Macau.

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Yadan Liu is a serious game producer and an animation director based in Shenzhen. Her serious games have had over a million users and have been selected for the “Internet Trends 2019”. Her animations have been popular all over the internet, with hundreds of millions of views. She is a PhD student in Visual Communication at the University of Macau.

Ze Gao is an Artist and Researcher based in Hong Kong and New York. He is a part-time researcher at the Tongji University - MIT Shanghai City Science Lab. His research spans different practices and interests, including AI-generated content, human-computer interaction, museum narratives, entertainment design, and mixed reality.



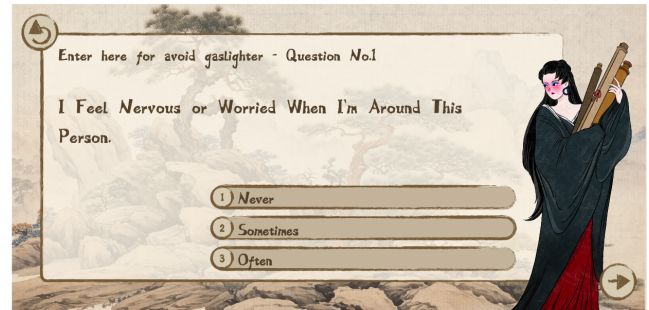
Main Interface: The primary game page displays seven characters from LiaoZhai.



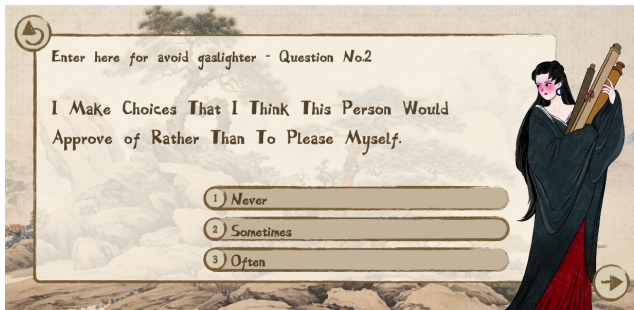
Accessing Original Stories: Users can click on each character to read their original LiaoZhai story.



Task Acquisition: Upon completing the reading of a story, users will receive three tasks related to gender topics.



Task Initiation: Each task comprises 5 questions with 3 options. Upon completion a total of 15 questions, users can generate up to 14,348,907 potential outcomes.



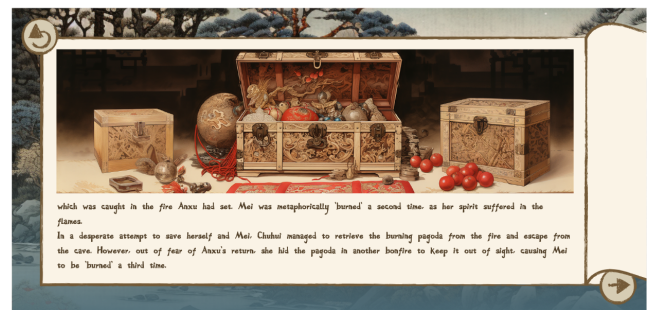
Task Progression: This interface displays the second question from the third task, which focuses on avoiding gaslighting.



Result Generation: Once users complete their tasks, the AI will create a new story based on their responses.



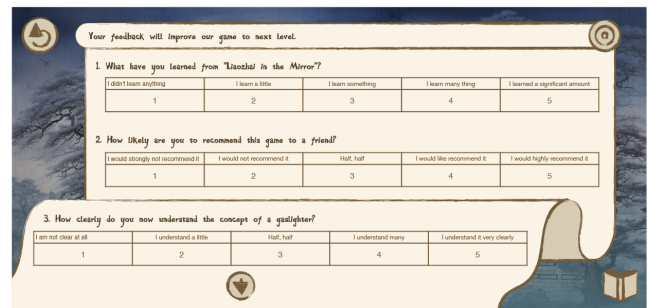
Initiation of New Story: The AI-generated narrative is presented with accompanying AIGC images and text.



Continuation of New Story: This interface shows a worse ending to Mei Sanniang's story based on incorrect answers.



Performance Feedback: Following the AIGC story, users will receive feedback on their performance along with explanatory suggestions.



Improvement Survey: Upon completion of the entire process, users can participate in a survey to communicate what they have learned from the game and provide feedback for the game's improvement.

Figure 8: Gameplay Explanation: A player's Character Selection of Mei Sanniang and the Final Result caused by the Wrong Responses. ©The Authors.