Exploring Multimodal Literacy through Digital Gameplay and Analysis---Chinese Adolescents' Learning Experience

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ARTICLE INFO	ABSTRACT

Purpose: Academic discourse underscores the potential of digital gameplay in facilitating adolescents' acquisition of multimodal literacy. Despite the enduring appeal of digital games among this demographic, their pedagogical merits remain predominantly overlooked and underutilized. Thus, this investigation seeks to delve into the realm of Chinese secondary students' multimodal literacy acquisition facilitated by engagement with digital gaming platforms. **Method:** Employing a qualitative case study methodology, this research investigated the learning dynamics and outcomes observed within two distinct cohorts of students, totalling eight participants. These students engaged in a nine-session program situated within a classroom environment, characterized by collaborative gameplay, and structured game analysis. Central to this approach was the utilization of a metalanguage framework specific to digital play. Various data collection techniques were employed, encompassing participant observation, interviews, electronic portfolios, and field notes, all of which underwent thematic analysis for comprehensive interpretation. **Findings:** The results uncovered the nuanced learning dynamics and outcomes pertaining to students' multimodal literacy across functional, critical, and aesthetic domains. This was achieved through a detailed examination of digital gameplay, focusing on representation, engagement, and organization perspectives. **Implications:** This research provided empirical evidence supporting the recognition of digital games as legitimate and authentic texts that extend the narrative scope of students' literacy endeavours beyond traditional confines, thereby warranting increased pedagogical emphasis within literacy education settings. Such emphasis is essential for cultivating adolescents' multimodal literacy skills, priming them for adept critical engagement with future media contexts. Moreover, the study offers practical insights for educators, facilitating the assessment of digital gameplay as a form of literacy practice and its subsequent integration within multimodal literacy instructional frameworks.

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Introduction

In the contemporary era characterized by pervasive digital technologies, adolescents engage with an array of multimodal texts encompassing images, sounds, gestures, and various other elements for purposes ranging from learning to entertainment and everyday communication (Mills et al., 2023). This evolving communicative landscape underscores the heightened importance of multimodal literacy (Jewitt & Kress, 2003), denoting the capacity to critically analyse and proficiently communicate through diverse multimodal representations (van Leeuwen, 2017). Multimodal literacy facilitates individuals' adept navigation, active engagement, and substantive contribution within the media-rich environment (Cope & Kalantzis, 2020; Yap & Gurney, 2023). Despite being dubbed "digital natives" (Prensky, 2003), adolescents do not inherently possess the multimodal literacy skills requisite for navigating intricate media practices (Mills et al., 2023; Selwyn, 2009). Consequently, the past two decades have witnessed a concerted emphasis on multimodal literacy within school curricula worldwide, evident at the policy level (Lim et al., 2022a). Nonetheless, its integration remains marginalized within classrooms predominantly characterized by print-based and examination-oriented literacy practices (Yi, 2014; Zhang et al., 2020), highlighting a pressing imperative for its enhanced implementation in educational settings.

Digital games, characterized as interactive experiences conducted on electronic platforms such as computers, smartphones, and gaming consoles (Marsh et al., 2020), present a potential avenue for nurturing adolescents' multimodal literacy (Gee, 2003; Mills et al., 2023). Scholars contend that engagement with digital games facilitates the cultivation of fluency in multimodal meaning-making among students, as they navigate various communicative modes concurrently to undertake critical decision-making, effective problem-solving, creative design, and active knowledge exchange within affinity groups (Gee, 2003; Marcon & Faulkner, 2016; Prensky, 2003; Stufft & von Gillern, 2021; Toh & Kirschner, 2023). Additionally, digital games offer rich narratives and contextual settings conducive to students' critical examination of multimodal texts (Bacalja, 2018; Theodoulou & Curwood, 2023). Furthermore, digital gameplay extends students' multimodal practices into a broader context through their engagement with and creation of game paratexts, which encompass all media products related to games, such as walkthroughs and reviews (Apperley & Walsh, 2012). Despite these potential benefits, digital gameplay remains inadequately represented within literacy classrooms (Stufft & von Gillern, 2021), thereby warranting further empirical inquiry.

Examining the role of digital games in fostering adolescents' multimodal literacy assumes particular significance within the context of China, the world's largest market for mobile games (Wang, 2023), where approximately 62.3% of minors engage in gaming regularly (China Internet Network Information Center, 2022). While considerable attention has been directed towards the potential risks associated with adolescents' digital gameplay, such as game addiction and inclinations towards violence (Li et al., 2023; Yang et al., 2023), these concerns are mirrored in the stringent regulations implemented by the Administration (2021), which restrict minors (under 18 years) to three hours of gaming per week (Xiao, 2021). Given the exponential growth of the gaming industry, such regulatory measures cannot fully eradicate the infiltration of digital games into the present and future lives of young individuals (Sanford & Madill, 2007; Toh & Lim, 2021). Conversely, enforced

disconnections may limit students' opportunities to develop multimodal literacy skills essential for critically and effectively navigating the complex media landscape (Kellner & Share, 2007), potentially exacerbating risks and perpetuating digital inequalities (Hampton & Shin, 2023). This is particularly concerning within secondary education settings, where students are undergoing a pivotal stage in the development of higher-order cognitive and social competencies, exploring self-identities, and deepening engagement with moral, ethical, and political dimensions of life through digital practices (Meriläinen, 2023; Steinberg & Morris, 2001).

Extant scholarly discourse proposes a promising strategy to ameliorate this concern: the integration of digital gameplay within school environments to facilitate critical multimodal meaning-making among Chinese adolescents. This instructional approach has the potential to transcend digital gameplay's conventional role as a leisure pursuit and instead transform it into valuable pedagogical opportunities (Bacalja, 2018). Moreover, it can serve to connect students' everyday experiences with literacy education within the formal school context (Apperley & Walsh, 2012), aligning with the emphasis placed on multimodal literacy within national curriculum standards (Ministry of Education of the People's Republic of China, 2022). Regrettably, empirical investigations into its implementation within Chinese classrooms are limited in scope. Consequently, the current study endeavours to offer fresh insights into the manner in which Chinese adolescents, particularly those at the secondary education level, engage in multimodal literacy learning through digital gameplay within classroom settings.

Literature Review

Theoretical Perspectives of Multimodal Literacy

Multimodal literacy, rooted in the social semiotic framework, posits that all processes of meaning-making are inherently multimodal and culturally situated (Kress, 2004). Contrary to being subordinate to language, various semiotic modes—such as images, sounds, and gestures—equally contribute to the expression of meaning within multimodal texts (Mills & Unsworth, 2017). Furthermore, semiotic choices are influenced by the agency and interests of meaning-makers within specific social contexts (Kress & Van Leeuwen, 2020a). Multimodal literacy encompasses a wide array of competencies and skills necessary for critically and effectively engaging with, interpreting, and producing multimodal texts tailored to particular contexts to achieve communicative goals (Jewitt & Kress, 2003; Mills et al., 2023).

The process of multimodal literacy learning involves cultivating semiotic awareness, which entails heightened sensitivity to the choices made in communication (Lim & Unsworth, 2023). This necessitates both textual and contextual understanding of the distinct affordances—potentialities and constraints—associated with various semiotic modes, including visual grammar and the norms governing their usage in specific contexts (van Leeuwen, 2017). Researchers examine the functions of semiotic modes in meaning-making through three primary lenses: representational (depicting ideas, events, and objects), interpersonal (manifesting social relationships), and compositional (constructing a coherent text) (Kress & van Leeuwen, 2020a). Moreover, multimodal literacy learning extends into the aesthetic realm, emphasizing an appreciation for the artistic deployment

of semiotic resources, as well as the critical dimension, which encourages a discerning analysis of the ideological, cultural, ethical, and political dimensions embedded within texts (Cope & Kalantzis, 2015; van Leeuwen, 2017).

Drawing upon these theoretical frameworks, this study conceptualizes multimodal literacy learning as the demonstration of sensitivity and knowledge in comprehending, interpreting, and utilizing multiple semiotic modes within game texts, encompassing functional, aesthetic, and critical dimensions.

Contextualizing Multimodal Literacy in Digital Gameplay

Gee (2003, 2005) innovatively linked digital gameplay with literacy through his foundational learning principles of video games. He emphasizes that digital games constitute a multimodal semiotic domain and affinity space (a social group with a shared goal), enabling learners to cultivate various literacy skills in multimodal communication through active, critical, embodied, reflective, and collaborative learning experiences. Building upon Gee's work, Apperley and Beavis (2013) propose a heuristic approach to integrating digital gameplay into literacy classrooms by presenting a model of critical games literacy, focusing on "games-as-action" and "games-as-text". Expanding on Apperley and Beavis's (2013) framework and drawing from multimodal literacy theories (Kress & van Leeuwen, 2002), Toh and Lim (2021) introduce a metalanguage that frames multimodal meaning-making in digital gameplay, categorizing it into representation, engagement, and organization. This framework offers educators comprehensive guidance on utilizing digital games as multimodal literacy practice (see Figure 1).

Representation pertains to "what is shown in the game", encompassing characters, themes, and contexts. Beyond surface-level comprehension, this dimension emphasizes delving into the deeper and broader implications of game texts, such as gender, race, themes, and designers' ideologies, addressing the socio-cultural nature of multimodal literacy and its critical dimension (van Leeuwen, 2017). Engagement refers to gamers' positions and perceptions during interactive gameplay, including perspective, emotions, and interactivity. This dimension emphasizes interpersonal meaning-making and the aesthetic aspects of multimodal literacy (Kress & van Leeuwen, 2020b; van Leeuwen, 2017). Organization encompasses the game's narrative and mechanical structures, offering insights into how semiotic modes contribute to a coherent game text, echoing compositional meaning-making (Kress & van Leeuwen, 2020b). This construct also provides a macroscopic view of players' game actions, including embodiment (learning from multisensory experiences) and subversion (unlearning and relearning for problem-solving), informing critical reflections on the overall digital gameplay experience as multimodal practice.

This framework systematically situates multimodal literacy within the distinctive landscape of digital gameplay, characterized by prominent sophistication and interactivity (Fernández-Vara, 2019). It thoroughly contextualizes multimodal literacy within the realm of digital gameplay and offers comprehensive guidance for students' multimodal literacy learning through critical engagement in digital gameplay. Consequently, this study adopts Toh and Lim's (2021) metalanguage of digital play as the theoretical framework due to its comprehensiveness and high relevance to the research objective. Building upon Toh and Lim's (2021), the following research question is proposed to frame this study.

- What are the modalities of involvement exhibited by Chinese secondary students in the process of multimodal literacy acquisition through the utilization of digital gameplay and subsequent analytical endeavours, viewed through the lenses of representation, engagement, and organization?
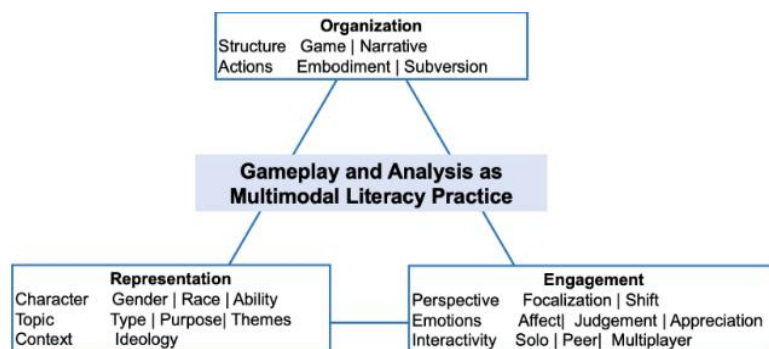

Figure 1: *Theoretical Framework of the Study.*

Past Empirical Studies

In the global academic landscape, prior investigations present abundant empirical substantiation elucidating the capacity of digital games to cultivate multimodal literacy among secondary students from various vantage points. For instance, within an Australian secondary educational setting, Bacalja (2018) facilitated students' exploration of digital games as cultural artefacts. Here, students discerned the affordances inherent in different modes for constructing genres and cultivated a critical awareness of power dynamics through classroom discourse. Tanner (2023) orchestrated dialogical analyses of the role-playing game Grand Theft Auto within two secondary classrooms in the United States, prompting students to scrutinize gender and racial stereotypes and violence vis-à-vis their own life experiences. Meanwhile, Stufft et al. (2021) nurtured multimodal analyses of Minecraft among middle school students in the United States, employing reflective writing to delve into the functioning of various multimodal modes in their decision-making processes. More recently, Theodoulou et al. (2023) inspired Year-10 Australian students to delve into a narrative-driven gaming experience. Here, students demonstrated a robust grasp of narrative elements and techniques, engaging deeply with the material and fostering heightened empathy through immersive gameplay, critical dialogues, and journal reflections.

The aforementioned studies underscore the role of digital games as exemplars of multimodal literacy (Gee, 2003) and inform the research framework of the current study. Nevertheless, the existing body of literature has predominantly focused on Western contexts, particularly the United States and Australia, where multimodal literacy education has been established early, and students typically engage in collaborative and exploratory learning methodologies (Mitchell Jr et al., 2017) This literature offers limited insights into understanding how students from diverse socio-cultural backgrounds approach such practices within the classroom, including those experiencing more teacher-centred literacy instruction and potential disincentives for digital gameplay. Regrettably, this gap persists in prior investigations concerning game-based literacy learning in China, which primarily

concentrate on leveraging educational games to bolster affective factors and enhance language proficiency (Hanghøj et al., 2022; Hung et al., 2018). Consequently, the manner in which Chinese students participate in multimodal literacy learning through digital gameplay remains ambiguous, thus necessitating comprehensive exploration.

Methodology

Establishing the Context

Conducted within a suburban secondary school located in northern China, this study involved a student population predominantly comprised of local residents. These students operated within an environment characterized by stringent regulations and prohibitions regarding the use of technology, both within the school premises and in their personal lives, with the aim of enhancing their concentration on exam-focused academic pursuits. Despite these regulations, it was reported by teachers that students continued to regularly engage with multimedia content. Subsequently, following the acquisition of institutional ethical approval and authorization from the school principal, the researchers introduced a nine-session game-based literacy program as an optional course within the school curriculum. Each session lasted 45 minutes and was conducted three times per week, with the objective of supplementing traditional textbook-based literacy education without interfering with regular subject instruction.

Research Participants

The study comprised eight participants aged 14, all enrolled in Grade 8, demonstrating limited exposure to multimodal literacy learning and varying degrees of gaming experience (refer to Table 1 for demographic specifics). They were purposefully selected using criterion sampling to facilitate the identification of "information-rich" cases conducive to comprehensive analyses (Merriam & Tisdell, 2017). Selection criteria encompassed possessing rudimentary digital literacy suitable for tablet-based tasks and expressing self-reported enthusiasm for digital gameplay to mitigate potential disengagement. The participants were evenly distributed into two groups, denoted as G1 and G2, to ensure equitable, participatory, and efficacious collaboration. G1 and G2 were identified as focal cases within the study due to the collaborative nature of the program activities.

Table 1

Demographic Information of the Participants

Group	Pseudonyms	Gender	Previous Gaming Experience
G1	Franklin	Male	Six years of gaming experience/weekly play
	Sharon		Three years of gaming experience/play games several times a month
	Queena	Female	Four years of gaming experience /weekly play
	Diana		Rarely play games previously
G2	Ray		Five years of gaming experience/weekly play
	Devin	Male	Two years of gaming experience/ play games several times a month
	Cecil		Three years of gaming experience/ weekly play
	Regan		Rarely play games previously

Game as a Primary Research Instrument

This study employed Tales of the Neon Sea (Figure 2), a single player role-playing game, as the primary tool for students' multimodal literacy learning. Set in a futuristic cyberpunk city, the game follows detective Rex and occasionally shifts to the cat William as they investigate crime cases through solving mini puzzles. The game was selected for its relevance to the research objective and appropriateness for the research context. Its sophisticated narratives and puzzle-centred mechanics offer ample resources for analysis in the representation dimension, promoting critical reasoning and problem-solving. The coherent storyline and varied mechanics facilitate students' engagement in multimodal meaning-making in the organizational dimension. Additionally, being a free-to-play point-and-click mobile game available in Chinese, it caters to players of different skill levels and minimizes potential language barriers for participants.
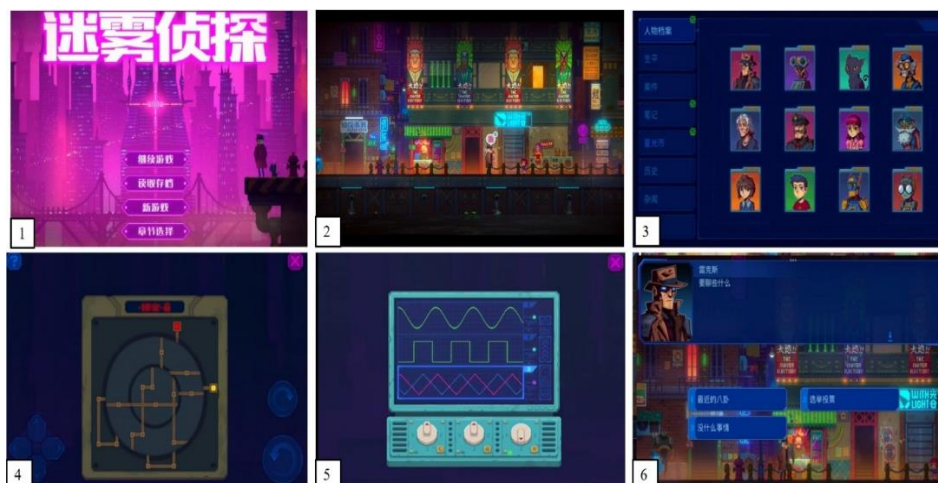

Figure 2: *Screenshots of Game Scenes.*

Research Design

This study adopted a qualitative case study methodology to conduct a comprehensive investigation from various perspectives (Merriam & Tisdell, 2017). A nine-session multimodal literacy program was administered by the principal investigator in collaboration with a literacy teacher, following a meticulously crafted syllabus (see Table 2). This syllabus delineated the structured instructional content for each session, drawing upon the theoretical framework proposed by Toh and Lim (2021). Moreover, the researchers integrated the "learning by design" framework developed by Cope and Kalantzis (2015) as the pedagogical approach to structure the class activities. This framework facilitates the progression of students through phases of experiencing, conceptualizing, analysing, and applying, thereby guiding them in the transformation of digital gameplay experiences into productive multimodal literacy practices. The adoption of this framework is grounded in its recognition as an effective knowledge process validated in previous empirical inquiries (Lim et al., 2022b).

Table 2

The Syllabus Design

Session	Instruction	Class Activities
Session 1	Introduction: learning objectives and syllabus	Sharing previous game experience. Experiencing: Group gameplay and analysis without guidance
Session 2	Introduce multimodal literacy into digital games based on Toh and Lim (2021)	Experiencing: Group gameplay Create an e-portfolio template for game analysis
Session 3	Conceptualizing "representation": game character/game topic/game context	Experiencing: Group gameplay Analysing and applying game analysis from the "representation" perspective.
Session 4–6	Class Briefing: Conceptualizing "Engagement" in the digital game: Perspectives/emotions/interactivity	Experiencing: Free gameplay Analysing and applying game analysis from the "Engagement" perspective.
Session 7	Class Briefing: Conceptualizing "Organization" in the digital game: Game structure/game action	Experiencing: Free gameplay Analysing and applying game analysis from the "Organization" perspective.
Session 8	Review the analytical framing of digital gameplay	Finalize the group e-portfolio of game analysis. (after-school practice on weekends).
Session 9	Closing: Presentation and discussion of the e-portfolio	Present the e-portfolio. Attend semi-structured group interviews

Particularly, the participants engaged in collaborative gameplay sessions using tablets, averaging 25 minutes per session. Concurrently, they conducted game analysis from the perspectives of representation, engagement, and organization, guided by a set of prompting questions (GQs) provided in a paper handout (see Table 3). Participants rotated roles as game controllers, observers, and note-takers, responsible for documenting their observations on the handout. Additionally, they were tasked with gathering evidence to substantiate their analyses, including capturing screenshots. At the conclusion of the program, both groups synthesized their game analyses into electronic portfolios (e-portfolios) using Microsoft PowerPoint on the tablet and subsequently engaged in group discussions during a collective interview.

Throughout the program, instructors delivered structured guidance. Each session commenced with a 5-10-minute debriefing led by the principal investigator, explicitly instructing participants in the metalanguage of digital gameplay (Toh & Lim, 2021) to facilitate their conceptualization of knowledge (Cope & Kalantzis, 2015). The researcher introduced fundamental concepts relevant to the analysis tasks through slides, incorporating specific examples from other games to establish connections between participants' life experiences and unfamiliar concepts, before assigning tasks outlined in the handout (e.g., completing GQs 3 to 6). Participants were encouraged to revise and update their responses in subsequent sessions, documenting their evolving insights. Additionally, instructors provided ongoing support during the participants' learning journey, offering supplementary explanations, posing probing questions, and monitoring task progression in real-time.

Table 3

Guiding Questions in the Students' Handout

Representation	1) What are the characters in the game?
	2) How are the characters designed? For example, their gender, race, and abilities.
	3) What game type is it?
	4) What are the purposes of the game?
	5) What do you think are the themes covered in the game?
	6) Where is the game situated, and what message doing the game designer intend to convey?
Engagement	7) Select a segment and talk about Rex's and William's experiences, feelings, and thoughts in the first-person perspective (use I experienced…I feel… I think…).
	8) Talk about your decision in the game scenario (Do you think robots should have equal political rights? Will you vote for the robot candidate?)
	9) Comment on the interactivity of the game (e.g., exploration space, feedback, and hints).
	10) What do you think about your teamwork? Is it helpful and effective? What have you learned from the collaboration?
	11) What do you feel about the aesthetic design of this game? Comment on its design elements, such as its images, animations, music, and character designs.
Organization	12) How does the game story unfold? How do you know that?
	13) What do you think of the game structure, for instance, its difficulty level, exploration space, obstacles, and biases embedded?
	14) If you can redesign the game, what do you want to change?
	15) Share the cases in which you adjusted your strategies to progress in the game. What have you learned from that?
	16) What have you learned from your multimodal gaming experience?

Data Collection and Analysis

The researchers implemented a variety of data-collection techniques to enhance data richness and triangulation (Merriam & Tisdell, 2017), as delineated in Figure 3. The sources of data included: 1) Thirteen video recordings (ranging from 20 to 30 minutes each) capturing the gameplay processes of the two groups, recorded using screen recording software on the tablet, which also captured their in-game verbal interactions. 2) Two e-portfolios authored by students (averaging nine slides each), showcasing the structured outcomes of participants' game analyses. 3) Two 20-minute semi-structured group interviews, allowing participants to elaborate further on their perspectives and deepen their insights collaboratively. 4) Field notes compiled by the researchers based on participant observation and various informal interviews conducted throughout the program. Prior to commencing the primary study, a pilot study involving two male secondary students from comparable socio-cultural backgrounds was conducted by the researchers to ensure the applicability and credibility of the research design.
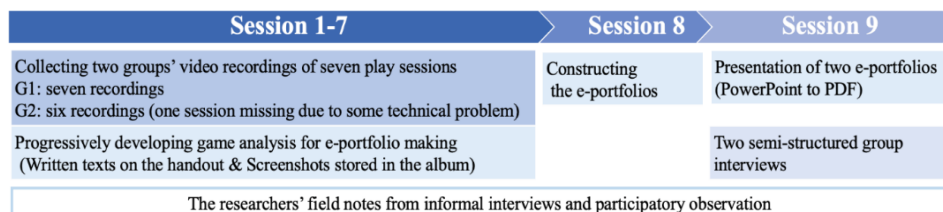

Figure 3: *Data Collection Process.*

Thematic analysis was employed to analyse the data using NVivo 12 (Braun & Clarke, 2012). The principal investigator translated the verbatim transcripts of interviews and e-portfolios into English, a process validated by a language translation expert. The researchers structured the students' multimodal literacy learning through digital gameplay into representation, engagement, and organization dimensions in a deductive manner to address the research inquiry. Inductive reasoning was utilized to identify sub-themes emerging from the data. For instance, frame-by-frame video analysis led to the identification of the code "mapping out individual characters' traits," based on students' detailed examination of characters' profiles and verbal expressions of characters' personalities during gameplay. This code was corroborated and enriched by textual and visual content in the e-portfolios and interview transcripts, then categorized under "understanding characterization" within the representation dimension. Subsequently, codes were arranged chronologically, aligned with provided scaffolding (e.g., guiding questions), and amalgamated into final themes. Member checking was conducted by the principal investigator with participants, and a dialogic reliability check was performed by discussing and confirming themes with the other two authors. Subsequently, the three authors collectively conducted another round of coding, building upon initial codes to further elucidate students' multimodal literacy within each category. For instance, the code "interpreting multimodal elements for characterization" was generated within the theme "understanding game characters".

Findings

Initially, participants engaged in a preliminary discussion regarding their prior experiences with digital gameplay, focusing predominantly on affective and relational aspects. They enthusiastically shared their lists of games. However, when prompted to critically reflect on their gameplay experiences, their responses were simplistic, often stating phrases such as "just for enjoyment" and "avoiding teaming up with inexperienced partners." These responses suggested a limited vocabulary and depth in discussing gameplay (Fernández-Vara, 2019). Subsequently, upon introduction to the course syllabus and learning objectives, students exhibited a more deliberate approach, engaging in meticulous examination of multimodal game texts while concurrently taking notes. They proceeded to deepen and broaden their understanding of gameplay from the perspectives of "representation," "engagement," and "organization," as elaborated upon in the subsequent sections.

Exploring the "Representation" Dimension
Understanding Characterization: From Individual Traits to Gender Stereotypes

Beginning from Session 1, both groups embarked on an exploration of characterization, initiating with the delineation of individual characters' attributes based on multimodal cues present in the game texts. An exemplary instance is evident in the detailed analysis conducted by Group 1 (G1) concerning the protagonist Rex, characterized by an examination of multimodal design elements encompassing his monologues, inventory images, and subtle decorative visuals (see Figure 4). This illustrates the students' discernment in attending to diverse communicative modes associated with character depiction to accomplish their objective of character analysis (van Leeuwen, 2017).

Equipped with textual knowledge to decode these elements, they actively scrutinized and interpreted multimodal indicators, aligning with their personal experiences. For instance, they correlated badges and trophies with high competence and inferred Rex's financial strain from his antiquated furniture. Guided questioning during interviews facilitated students in elucidating how various narrative elements contribute to characterization. For instance, Sharon articulated that facial expressions and symbolic decorations enrich characters' personalities, providing an example: "a solemn gaze suggests that the leader is serious, while the rose renders him sociable and romantic; you know, roses are a symbol of romance." This indicates students' progression in explicit comprehension of the affordances of multimodal semiotic modes in representational meaning-making (Kress & Van Leeuwen, 2020a).
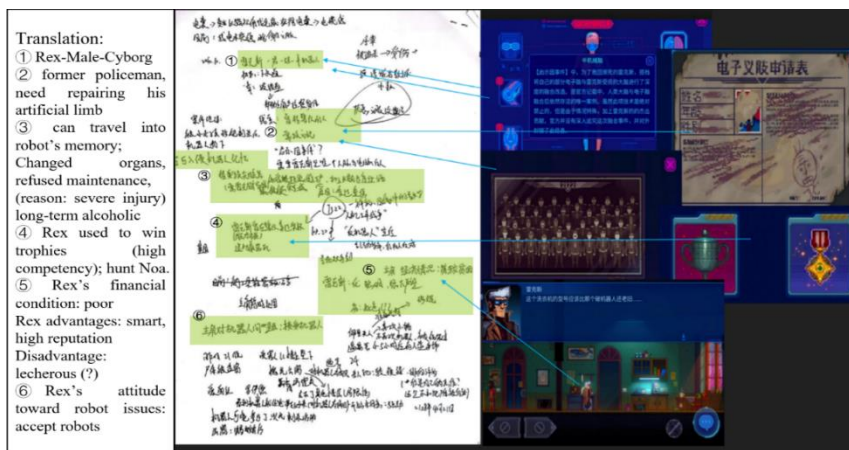

Figure 4: *Character Analysis in the E-Portfolio by* G1.

Moving to Session 3, students delved into an examination of potential gender biases in game character design, scaffolded by Guiding Question 2 (GQ2). Initially, this task proved challenging due to participants' narrow conception of "bias," as Cecil acknowledged, "I thought bias is about using unkind words or treating someone badly." With additional elucidation, G1 tentatively commented on the stereotypical portrayal of female characters, asserting that "women are always gentle" (Franklin) and "little girls are always depicted as innocent" (Sharon). G2 noted that "males occupy more significant roles like police officers" and "victims are typically depicted as weak, elderly women, whereas suspects are dejected males." Despite oversimplifications and generalizations, their analyses signify a burgeoning awareness of gendered representation inherent in privileged, dominant, and at times aggressive male characters juxtaposed with underrepresented, supportive, and vulnerable females (Toh & Lim, 2021). This reflects an emerging comprehension of socio-cultural implications in multimodal texts extending beyond explicit language and actions, addressing multimodal literacy learning within the critical dimension (Cope & Kalantzis, 2015; van Leeuwen, 2017). Nevertheless, the students exhibited a shortfall in extending gender stereotypes to a wider societal context pertinent to their own identities, including discussions and critiques of societal expectations regarding their gender roles, to which they responded with limited emphasis, underscoring the necessity for further instruction.

Probing the Game Topic: From Salient Game Contents to a Wider Social Context

Concurrently with the analysis of game characters, both groups also engaged in game topic analysis. Guided by Guiding Questions 3 to 5 (GQ3-5), their comprehension of game topics progressed from initial literal descriptions of concrete events (e.g., Rex fixing the machine) in Session 1 to higher-level interpretations of the main game features by Session 3. "I did not grasp the concept of topic analysis initially, so we simply recorded the unfolding events. The questions provided us with directions on where to focus," remarked Regan. Specifically, both groups identified the game genre as a "puzzle game" and conceptualized the primary semiotic elements underlying this genre in their e-portfolios, such as "suspense" and "puzzle-solving." They also inferred the game's objectives based on their immersive gaming experiences, such as "enhancing problem-solving skills" and "analytical ability." Moreover, they discerned the overarching game theme of "conflicting human-robot relationships" by synthesizing multimodal information collected during gameplay, including dynamic visuals depicting robots harming humans, a human character's written diary expressing resentment toward robots, and background imagery such as anti-robot posters (refer to Figure 2-2). Their justifications demonstrate an appreciation of the collective contributions of multiple semiotic modes to multimodal meaning-making and how they accentuate pertinent information to ensure coherence (Kress & Van Leeuwen, 2020a). However, their analysis remained confined within the game context at this stage.

By Session 6, students delved into the socio-cultural implications of the game topic, emphasizing the critical dimension of multimodal literacy (van Leeuwen, 2017). Notably, the game scenario (GQ8) devised by the instructor played a pivotal role in prompting students to adopt this critical perspective. Responding to GQ8, students proactively initiated classroom discussions to explore the future dynamics of human relationships with rapidly advancing AI technology, offering critical insights from diverse perspectives. For instance, Devin argued:

If robots were ordinary people, and we humans were like emperors or something, long-term exploitation would lead to rebellion, just like the peasant uprising in history…if they are treated unequally, they will start wars and damage the economy, as well as cause casualties.

Detractors expressed apprehensions regarding the potential repercussions of affording equal rights to robots, citing concerns such as "disrupting the ecological equilibrium" (Queena), and raised queries about the rationale behind promoting AI technology that could impinge upon human interests (Ray). The students' deliberation underscored how concepts presented in the game can elicit discussions on broader societal contexts, drawing upon students' prior knowledge and personal experiences, and involving them in addressing socially pertinent real-world issues as proactive social participants (Bacalja, 2018).

Exploring the "Engagement" Dimension
Active and Critical Multimodal Interactions Across Spaces

Throughout the gameplay, the participants demonstrated a profound engagement in multimodal interactions spanning the virtual and real realms. Within the game

environment, both groups exhibited a keen sensitivity to procedural information conveyed through various modes and adeptly navigated, identified, interpreted, and applied these features to progress through the game, despite their lack of prior experience with it (Jewitt & Kress, 2003; Stufft & Gillern, 2021). They promptly responded to interactive icons for puzzle-solving, attentively read the on-screen written instructions, frequently consulted the mission board and inventory items for detailed guidance, and scrutinized subtle visual elements for additional clues, indicative of a discerning semiotic awareness (Toh & Lim, 2022). Engaging in solving mini-puzzles entailed students in evidence-based reasoning and informed decision-making, employing a feedback loop and effectively leveraging multimodal cues for problem-solving. For example, when addressing a lock puzzle (refer to Figure 2-4), G2 manipulated the maze by rotating the wheels, carefully observed the evolving patterns, and devised a path for the yellow spot by deducing the correct route in reverse from the endpoint. Guiding Question 9 (GQ9) and subsequent interviews prompted the students to examine how the game conveys messages to players. Sharon remarked: "Written instructions are crucial for understanding the basic rules, but they tend to be abstract. Visual cues offer more direct hints, such as indicating being stuck or displaying red or green lights." G2 noted the utilization of the auditory mode (e.g., sound effects) as feedback signalling mission completion, and the linguistic mode through nonplayer characters' (NPCs) warnings to inform players of boundaries. Consequently, the students transcended mere gameplay progression as avid players to contextualize their semiotic understanding of how various communicative modes operate in engaging with the audience (van Leeuwen, 2017).

During gameplay, all students engaged in close communication, collaboration, and knowledge exchange within the affinity space, actively brainstorming strategies and sharing expertise (see Figure 5). Experienced gamers like Franklin and Ray mentored less experienced group members, who eagerly expressed opinions with gestures. This demonstrates digital gameplay as a social literacy practice, enabling diverse participation in generating signs, expressing ideas, and distributing knowledge (Gee, 2005; Mills et al., 2023). It enriched students' identities as detectives, game experts, and learners (Gee, 2003). Guided by GQ10 in Session 4, students expanded their understanding of collaborative gaming, recognizing its role in fostering collaborative skills and offering diverse perspectives (Ray). G1 reflected on the importance of settling disagreements and fair labour division for effective teamwork, highlighting its relevance to future endeavours.

Figure 5: *Students' Engagement with Digital Gameplay.*

Enriching Emotional Connections in the Gameplay

Participants displayed emotional connections beyond sensory pleasure, empathizing with game characters, reflecting on ethical decisions, and appreciating the game's aesthetic design (Toh & Lim, 2021). In Session 1, some students empathized with characters like Rex and a boy with a dying dog, showing an initiative to interpret emotions through visuals, language, gestures, and actions (Kress & Van Leeuwen, 2020b). Writing first-person vignettes (GQ7) deepened students' involvement, allowing them to articulate characters' emotional, cognitive, and behavioural states more profoundly (see Figure 5-2). For instance, G1 composed a short story encapsulating Rex's reflection on robot rebellion and political corruption, reflecting enhanced emotional and intellectual engagement.

The game scenario task (GQ8) prompted students to critically reflect on ethical decisions within the gameplay, such as considering the consequences of voting for a robot candidate as mayor. Some students expressed concerns about potential repercussions on human employment, indicating their engagement in ethical dilemmas and personal implications (De Sousa et al., 2018).

Guided by GQ11, participants explored the aesthetic dimension of multimodal literacy by appreciating the game's visual and audio designs. Both groups highlighted vibrant colours and immersive sound effects, showcasing their understanding of how these elements contribute to creating an engaging gaming experience (van Leeuwen, 2017).

Exploring the "Organization" Dimension
Emerging Understanding of Game as Multimodal Composition

Following six sessions of gameplay and analysis, students engaged in a macroscopic examination of the game's narrative and mechanics in Session 7, guided by GQ13. They identified puzzles as the main component of game mechanics, with G1 highlighting potential incoherence in level design to challenge players' competencies without hindering progress. Franklin inferred the rationale behind such challenges, showcasing his understanding of designers' intentions (Bacalja, 2018).

Additionally, students explored the game's narrative style and unique storytelling features prompted by GQ12. They noted non-linear storytelling techniques like "fragmentation" and "flashbacks," recognizing players' active roles in constructing narratives. Both groups advocated for more dialogue choices to enhance player agency, demonstrating their ability to critically evaluate game elements (van Leeuwen, 2017).

Reflection on Multimodal Learning from Game Actions

At the program's conclusion, participants reflected on the educational value of multimodal gameplay as prompted by GQ14 and 15. Their responses evolved from initial casual remarks to more insightful reflections, emphasizing skill enhancement and knowledge acquisition. For instance, G1 outlined cognitive skills developed during their detective experience, such as puzzle-solving and case analysis, and connected these skills to real-life problem-solving. Franklin highlighted the improvement in observation skills and the ability to see things from different perspectives. G2 underscored the authentic learning contexts provided by gameplay, documenting the acquisition and application of

science concepts like "processor" and "decoder." They recognized the practical application of physics knowledge in solving in-game problems. These reflections transformed students' perceptions of digital games from mere entertainment to meaningful educational tools, challenging common biases against digital gameplay. Queena remarked on this shift in perspective as:

I used to just play for fun and people around me kept saying it is a waste of time, but now I can say we are wrong. Games can be like textbooks, and there are so many things worth analysing.

Of particular importance, students emphasized the value of multimodal learning facilitated by digital gameplay as a supplementary aspect to language-centric classroom instruction. Franklin articulated, "Our classroom emphasis was solely on language. However, analysing this game prompted me to consider the functioning of other elements, which are crucial in conveying ideas and more closely tied to our daily experiences." This suggests that structured classroom education enabled students to appreciate the significance of their prior engagement in multimodal literacy practices, countering the misconception that such activities are futile.

Discussion

This investigation delved into the multimodal literacy development of Chinese secondary students through the utilization of digital gameplay and subsequent analysis within the classroom setting. Results underscored students' adeptness in leveraging digital gameplay to enhance multimodal literacy across functional, aesthetic, and critical dimensions, as outlined by Toh & Lim (2021) and van Leeuwen (2017). This study contributes empirical substantiation to the scant research corpus, bolstering the recognition of digital games as valuable educational resources for multimodal literacy acquisition within educational contexts (Apperley & Beavis., 2013; Gee, 2003; Toh & Lim, 2021). Furthermore, it broadens the societal scope of inquiry by offering insights from a less-explored demographic.

Exploration of the "representation" dimension revealed students' engagement in multimodal literacy practices, involving navigation, comprehension, and interpretation of diverse semiotic modes to construct their understanding of game narratives (Jewitt & Kress., 2003). Through selection, synthesis, and presentation of multimodal evidence, students conceptualized, analysed, and applied knowledge of design elements to characterize and construct game topics (van Leeuwen, 2017). Additionally, game narratives provided a platform for students to critically examine prevalent viewpoints within multimodal texts, such as gender stereotypes, and partake in consequential social dialogues. This underscores the role of digital games as authentic texts, expanding students' narrative horizons into their everyday experiences, corroborating prior research findings (Bacalja, 2018; Tanner, 2023; Theodoulou & Curwood, 2023).

However, the study uncovered limitations in students' depth of analysis regarding socio-cultural implications, necessitating increased scaffolding from educators to bridge virtual and real-world contexts. Likely factors contributing to this include students' limited background knowledge of relevant concepts (e.g., gender and AI technology), insufficient experience in openly discussing social issues within the classroom, and time constraints.

This underscores the imperative of integrating digital gameplay into formal education in China to foster students' roles as informed and engaged citizens (Mills et al., 2023).

In terms of "engagement," this investigation illustrates how digital gameplay immerses students in multi-dimensional interactions across cognitive, social, and emotional realms (Gee, 2005; Toh & Kirschner, 2023). It furnishes a dynamic, sensory-rich milieu wherein students continually engage with, interpret, and respond to diverse modes of information to facilitate discerning decision-making and adept problem-solving, aligning with the observations of Toh and Lim (2022) and Stufft & Gillern (2021). Moreover, it fosters collaborative social literacy practices within affinity groups, facilitating the acquisition of distributed knowledge and negotiation of cultural identities through embodied experiences, a phenomenon well-documented by Gee (2003) and Marcon and Faulkner (2016). Additionally, consistent with prior research (Toh & Kirschner, 2023), this study underscores the role of digital gameplay in enhancing emotional learning, evidenced by students' heightened empathy towards game characters (Toh & Lim, 2021) and their ability to make reflective and morally accountable judgments as stakeholders (De Sousa et al., 2018).

Furthermore, this study highlights how the rich array of design resources inherent in digital games facilitates multimodal literacy development from an aesthetic perspective, a facet often overlooked in previous inquiries (van Leeuwen, 2017). However, student analyses regarding "engagement" exhibited limited specificity and depth, suggesting the need for more explicit metalanguage for conceptualization, targeted guidance to encourage an emic perspective, and extended time for deepening engagement.

Examining the "organization" dimension provided students with an opportunity to dissect how various multimodal components within the game are harmonized to achieve cohesive compositional meta functions (Kress & Van Leeuwen, 2020b). Despite their initial simplicity, students demonstrated an expanded viewpoint regarding digital games as multimodal compositions intertwining narrative and interactive structures, co-constructed by gamers (Fernández-Vara, 2019; Stufft & Gillern, 2023). Additionally, they delved into the intentions behind game designers' semiotic choices (Bacalja, 2018). Upon reflection, students externalized their learning experiences, recognizing digital gameplay as a meaningful and authentic literacy practice integrating subject knowledge and skill development (Apperley & Beavis, 2013; Gee, 2005; Prensky, 2003). However, there were implicit learning benefits, such as subversive learning in puzzle-solving activities, indicating the necessity for educators to scaffold such submerged learning benefits to deepen students' multimodal literacy learning (Stufft & Von Gillern, 2021).

Furthermore, this study contributes to elucidating the dynamics of students' multimodal literacy learning mediated by systematic guidance. Analysis of their gameplay and reflections unveiled their continual progress as multimodal meaning-makers. They engaged with multiple semiotic modes across contexts to advance the game while simultaneously gathering relevant information for multidimensional analysis. Drawing on personal knowledge, they conceptualized and inferred the unknown, constructing contextual understanding of the game (Cope & Kalantzis, 2015). They devised their approaches to puzzle-solving, teamwork, and the application of experiential, conceptual, and critical knowledge to structure their e-portfolios (Cope & Kalantzis, 2015). Moreover, they explored ideological implications and designers' intentions embedded in multimodal texts in relation to real-world social and

political contexts (van Leeuwen, 2017). Their critical engagement starkly contrasts with their initial simplistic responses, highlighting the significance of integrating classroom-based digital gameplay for students' multimodal literacy learning, as supported by established theories (Cope & Kalantzis, 2015; Toh & Lim, 2021).

Conclusion

In conclusion, digital games enrich multimodal literacy and positively impact adolescents' learning and growth. Educators must reconsider outdated views on literacy and embrace digital gameplay as valuable literacy practice. It's vital to move away from the "protectionist approach" that segregates gaming from learning and instead integrate games into classrooms to help students maximize their learning potential.

This study provides practical insights for educators on integrating digital gameplay into multimodal literacy classrooms. Its theoretical framework and syllabus offer valuable guidance for practitioners, especially newcomers, to effectively incorporate games for literacy practice. The findings highlight the importance of scaffolding techniques, such as class briefings and evidence-based analysis tasks, in facilitating students' multimodal learning. Moreover, the study offers reference points for evaluating students' competency levels and designing age-appropriate activities. Additionally, it contributes to the theoretical understanding of digital play, paving the way for enhanced critical analysis and recognition of the pedagogical value of gaming.

This study acknowledges several limitations, notably the restricted generalizability of findings due to the small sample size. Additionally, constrained by time, the breadth of dimensions explored limited the depth of participants' investigation in each area, and reliance on a single mobile game may not have provided optimal resources for thorough analysis in every aspect. Nevertheless, the study facilitates a shift for students and educators, initially perceiving digital gameplay solely as entertainment, towards recognizing its potential for multimodal literacy learning. This awareness enables them to engage with digital gameplay more critically and appreciate valuable learning benefits in their everyday media practice. This study serves as a starting point for future research to initiate comprehensive digital game-based multimodal literacy programs with extended durations for more in-depth exploration. Furthermore, employing a pre and post-test research design can facilitate comparison and identification of students' multimodal literacy progress. Introducing several high-quality games with distinct features as abundant resources can enhance students' critical understanding through comparative analysis and facilitate the transfer, reconstruction, and internalization of their knowledge in digital game design.

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