



Serious Games and Critical Thinking Disposition: A Systematic Literature Review

Juegos serios y disposición de pensamiento crítico: una revisión sistemática

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ABSTRACT

Serious games have emerged as powerful educational tools designed with explicit pedagogical goals. Recognising their potential and the pivotal role of critical thinking in addressing contemporary societal challenges, this study aims to explore the relationship between serious game design and the fostering of critical thinking disposition. Grounded in constructivist learning theory, this research employs the PRISMA 2020 guidelines to conduct a systematic review across five electronic databases, identifying 1,614 potentially relevant works, with four studies meeting the inclusion criteria. The analysis revealed several design elements consistently linked to the cultivation of critical thinking disposition within serious games. These elements include the exploration of diverse character perspectives, scenario-based approaches, emotional engagement, gamification techniques, adherence to psychosocial principles, and autonomy-enhancing, player-centric designs. Notably, these elements were interconnected, contributing synergistically to the immersive gaming experience. Through constructivist learning principles, interactive narratives, and problem-solving mechanisms, serious games provide opportunities for learners to engage deeply with complex problems, reflect on their decisions, and develop innovative solutions. Despite these promising findings, the study acknowledges limitations such as the limited availability of comparable articles in the existing body of literature. In conclusion, this research underscores the significance of serious games in promoting critical thinking disposition and highlights avenues for future empirical investigations in this vital intersection of education and gaming.

RESUMEN

Los juegos serios han surgido como poderosas herramientas educativas diseñadas con objetivos pedagógicos explícitos. Reconociendo su potencial y el papel fundamental del pensamiento crítico en el abordaje de los desafíos sociales contemporáneos, este estudio tiene como objetivo explorar la relación entre el diseño de juegos serios y el fomento de la disposición al pensamiento crítico. Basada en la teoría del aprendizaje constructivista, esta investigación utiliza las directrices PRISMA 2020 para realizar una revisión sistemática en cinco bases de datos electrónicas, identificando 1,614 trabajos potencialmente relevantes, de los cuales cuatro cumplieron con los criterios de inclusión. El análisis reveló varios elementos de diseño vinculados de manera consistente con el cultivo del pensamiento crítico en los juegos serios, como la exploración de perspectivas de personajes, enfoques basados en escenarios, compromiso emocional, técnicas de gamificación, adhesión a principios psicosociales y diseño centrado en el jugador que promueven la autonomía. Estos elementos estaban interconectados, contribuyendo sinérgicamente a la experiencia de juego. A través de los principios del aprendizaje constructivista, narrativas interactivas y mecanismos de resolución de problemas, los juegos serios proporcionan oportunidades para que los y las estudiantes se involucren profundamente con problemas complejos, reflexionen sobre sus decisiones y desarrollen soluciones innovadoras. A pesar de los hallazgos prometedores, el estudio reconoce limitaciones, como la disponibilidad limitada de artículos comparables. En conclusión, esta investigación destaca la importancia de los juegos serios en la promoción del pensamiento crítico y señala vías para futuras investigaciones en esta intersección entre educación y videojuegos.

KEYWORDS / PALABRAS CLAVE

Videogame, Game Studies, Attitude, Willingness, Critical Thinking, Educational Technology.
Videojuego, estudios de juegos, actitud, predisposición, pensamiento crítico, tecnología educativa.

1. Introduction

In recent years, serious games have gained significant attention in education (Daoudi, 2022; Reyes-de-Cózar & Merino-Cajaraville, 2025). Serving as robust educational tools, these games offer an immersive and interactive approach that effectively captivates students while enhancing academic performance (Díaz et al., 2024). Beyond facilitating learning, they also contribute significantly to the development of critical thinking (Gurbuz & Celik, 2022; Morard, Sanchez, & Bonnat, 2023). Dewey (1910) characterises critical thinking as “suspended judgement”, underscoring the significance of inquiry in comprehending problems before attempting to solve them. Within this context, cultivating a positive disposition toward critical thinking involves nurturing what the American Psychological Association identifies as a “critical spirit” (Facione, 1990)- a trait inherent in individuals inclined to employ critical thinking skills.

Widely acknowledged as a fundamental competency, critical thinking equips individuals with the capacity for logical and ethical reasoning (Ennis, 2018; Paul & Elder, 2019), empowering them to make informed decisions across diverse domains of life (Dwyer, 2017). Within the context of 21st-century education, critical thinking assumes a pivotal role, correlating with improved academic achievement (Li et al., 2024), more effective decision-making (Butler, Pentoney, & Bong, 2017), and the cultivation of ethically responsible citizens (Aktoprak & Hursen, 2022). In our fast-evolving world characterised by significant challenges such as climate change, political polarisation, the global digital divide, and ethical dilemmas associated with technology, the importance of critical thinking in addressing these complex issues becomes increasingly evident.

1.1. The role of Serious Games in Cultivating Critical Thinking Dispositions

While critical thinking is often understood as the orchestration of skills, dispositions, and knowledge, research has mainly focused on critical thinking skills (Rauscher & Badenhorst, 2021). However, critical thinking disposition, characterised as intellectual tendencies or personality traits, play a crucial role in shaping cognitive processes (Fierro & Di Doménico, 2017). There is a positive correlation between critical thinking skills and dispositions, with development in one domain significantly reinforcing the other (Profetto-McGrath, 2003). Engaging critical thinking skills demands cognitive effort, emphasising the importance of an individual’s motivation to recognise and manage emotions, instincts, or intuitions (Dwyer, 2017). These dispositions enable the application of critical thinking skills and are thus fundamental to fostering critical individuals (Ennis, 1996; Facione, 1990; Siegel, 1999). Facione (2000) describes the disposition toward critical thinking as an internal motivation to consistently apply critical thinking skills in decision-making, whether in belief formation or action selection.

Numerous experts have delineated key dispositions characteristic of effective critical thinkers, including behaviours such as inquiry, self-directed learning, thoroughness in information assessment, open-mindedness, truth-seeking, honesty, and a determination to overcome cognitive biases (Ennis, 1996; Facione, 2000; Halpern, 2014). These dispositions form the basis for distinguishing genuine critical thinkers from skilled manipulators (Paul & Elder, 2019) and are thus indispensable for refining and employing argumentative and problem-solving skills ethically (Halpern, 2014).

Moreover, contemporary educational paradigms increasingly incorporate ethical, civic, and cultural dimensions of critical thinking (Davies & Barnett, 2015), highlighting education’s role in nurturing human values essential for a thriving democratic society (Gisewhite, 2023). This underscores the importance of emphasising the development of critical thinking dispositions. In this respect, it is worth mentioning that although some students may naturally display critical thinking traits, such as intellectual curiosity, critical thinking itself does not develop naturally (Paul & Elder, 2019). On the contrary, the mind has inherent tendencies, like confirmatory bias, which can hinder critical thinking. Therefore, practicing critical thinking requires deliberate and demanding cognitive effort. Consequently, it must be intentionally cultivated, taught, and evaluated, particularly in educational settings.

Constructivism, grounded in the work of Piaget (1971) and Vygotsky (1978), offers a comprehensive framework for actively promoting critical thinking. This learning theory emphasises the role of meaningful experiences and collaborative interactions in helping students construct understanding. By creating interactive and engaging environments, it encourages learners to reflect on their experiences and integrate new knowledge, supporting the deliberate effort necessary for developing critical thinking (Le & Nguyen, 2024).

Regarding serious games, the literature encompasses various definitions of the term “serious game”. Abt (1970) initially introduced the concept, defining serious games as those designed primarily for purposes beyond

mere entertainment. Zyda (2005) provided a more specific characterization, describing serious games as mental contests played on a computer to advance objectives related to various fields. Djaouti and colleagues (2011) have however contributed a more comprehensive definition, depicting serious games as computer applications initially intended to integrate elements of seriousness with instruction, learning, communication, or information dissemination, while incorporating interactive aspects akin to video games. Serious games find successful applications across diverse domains such as healthcare, education, military and defence, and ecology (Bakhtiari & Habibzadeh, 2023). Importantly, these games cater to audiences of all age groups (Daoudi, 2022). Within this context, Serious Educational Games (SEGs) stand out. SEGs adopt a directed pedagogical approach, aiming to facilitate training activities and impart educational content (Annetta & Cheng, 2008). They span academic disciplines and educational levels, offering a viable alternative to traditional teaching models and contributing to enhanced student motivation and improved learning outcomes (Gómez & Suárez, 2021; Lamb et al., 2018).

SEGs incorporate virtual environments that provide students a realistic opportunity to actively practise, improve, and assess a range of competencies (González-Mendivil, Rodríguez-Paz, & Zamora-Hernández, 2021). They additionally serve as a learning tool that is accessible anytime and anywhere. Research suggests that these gaming environments can provide a rich educational experience, resulting in enhanced cognitive and affective engagement (Gatti, Ulrich, & Seele, 2019), increased motivation and satisfaction among students (Arruzza & Chau, 2021), and the opportunity for students to cultivate skills and apply knowledge within the context of learning while acquiring new abilities in novel settings (Koivisto & Hamari, 2019). For example, Gee (2007) argues that as games become more complex, they include features like intelligent tutors, scaffolding, and affinity groups for learning to help players understand the increasingly intricate interfaces and systems. However, as the author argues, these aspects of game worlds that are conducive to facilitating learning are often challenging to replicate in a traditional classroom setting.

One learning principle that should be of particular interest to online educators is what Gee calls the “psychosocial moratorium principle” (2003, p. 62). In video games, this principle encourages players to take risks they might avoid in the real world, as the consequences are less severe; typically, the worst outcome is the virtual regeneration of a character at a save point. This safe environment allows students to venture outside their comfort zones and explore unfamiliar concepts. Conversely, game-based environments may elevate discursive risks, potentially leading to more aggressive behaviour and reduced sensitivity to differences in ideology and culture due to decreased accountability. Discursive risks, which refer to the potential negative consequences of engaging in verbal or written exchanges within the gaming environment, can include behaviours such as trash-talking or heated debates among players. These risks are heightened by the relative anonymity and reduced accountability often found in online gaming spaces. However, Gee (2007) later suggests that when approached with thought, reflection, and engagement, video games can be beneficial to one’s soul. This underscores the potential of games as educational tools, offering opportunities for critical reflection and analysis while keeping students engaged in a familiar medium.

Despite their potential, SEGs face challenges, particularly in finding the balance between pedagogical effectiveness and fun (Mabrito, 2016; Silva, 2020). There is also a scarcity of research exploring the suitability of SEGs design for children (Valenza, Gasparini, & da S Hounsell, 2019) and their potential impact on critical thinking dispositions. Moreover, understanding the unique design considerations for SEGs is crucial for enhancing educational game development and developing students’ critical thinking dispositions. Filling this research gap is essential for maximising the educational potential of serious games.

1.2. Current Study

While there has been extensive research on critical thinking skills, critical thinking dispositions have unfortunately received insufficient attention (Rauscher & Badenhorst, 2021). This disparity is partly due to the challenges associated with cultivating and assessing these enduring traits. Similarly, within the context of serious games, which primarily aim to foster specific skills, exploration of their impact on critical thinking dispositions has been limited. Addressing this gap, our systematic literature review embarks on a significant scholarly journey. While abundant research explores the influence of serious games on learning outcomes and critical thinking skills development (Seifi et al., 2015; Valenza et al., 2019), their impact on critical thinking dispositions remains relatively underexplored. Motivated by the scarcity of research synthesising the relationship between serious games and critical thinking disposition development, our study seeks to fill

this void. Therefore, our primary aim is to navigate this paucity and contribute to a holistic understanding of serious games' multifaceted role in educational settings concerning critical thinking disposition development.

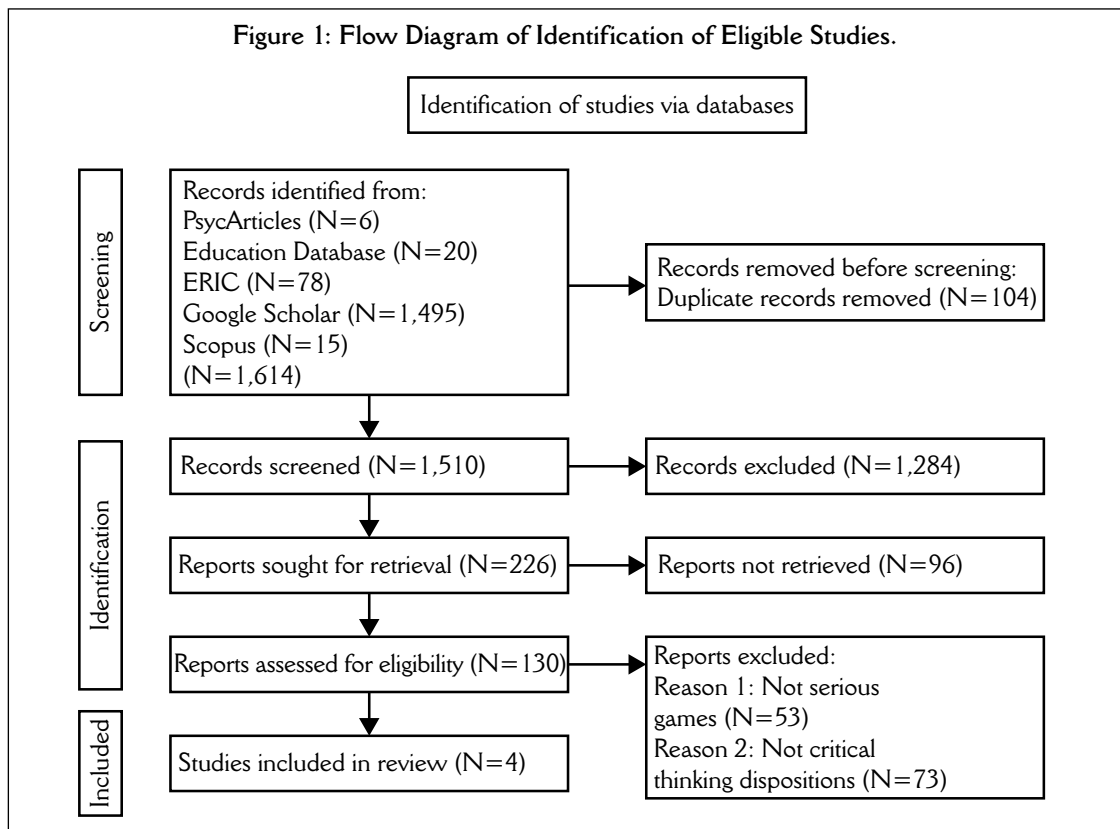
Recognising the significance of understanding the interplay between serious game design and the development of critical thinking dispositions, our research carries relevance for educators, game designers, and researchers alike. Exploring this alignment offers insights to enhance serious game design practices and foster critical thinking competence in learners. Our study intentionally avoids conducting empirical analyses, such as a meta-analysis, recognising the scarcity of comparable articles in the existing literature, based on a preliminary search. Instead, we embrace a purposeful exploratory approach to uncover the intricate complexities inherent in the relationship between serious games and the development of critical thinking dispositions.

By shedding light on this connection, our research aims to provide valuable insights for both game design practices and critical thinking disposition cultivation. Our overarching objective is to contribute to educational advancements and societal impact. This foundational exploration encourages future empirical investigations into this pivotal intersection within education. The study addresses the following research question (with two sub-research questions):

1. What is the relationship between serious games design and the development of critical thinking disposition?
 - i. What are the key design elements of serious games that have been linked to the development of critical thinking disposition?
 - ii. What pedagogical models have been used to frame the role of serious game design in relation to the development of critical thinking disposition?

2. Material and Methods

To address the gap in understanding the relationship between serious game design and the development of critical thinking dispositions, we conducted a systematic review following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines (see Figure 1).



Five electronic databases were searched for relevant literature: APA PsycArticles, Education Database, Eric, Google Scholar, and Scopus. The search, conducted in December 2023, focused on works published up to December 2023. The search strategy employed was: (“serious educational game”) OR (“digital serious game”) OR (“virtual serious game”) OR (“online serious game”) OR (“digital educational game”) OR (“virtual educational game”) OR (“online educational game”) OR (“educational video game”) OR (“e-learning game”) AND (“critical thinking disposition”) OR (“critical thinking attitude”).

Inclusion criteria comprised English-language, peer-reviewed articles with full-text availability, without restrictions on geographical location, document type, publication time frame, or sociodemographic factors. This broad scope ensured a diverse pool of studies while focusing on accessibility and quality. The decision to limit the set to English-language articles was based on practical considerations of analysis and interpretation, while the lack of temporal and geographical restrictions allowed for a comprehensive understanding of subject across contexts and time periods. The initial search yielded 1,614 potentially relevant academic works, with 104 duplicates removed. Following a two-stage screening process, 130 articles proceeded to full-text assessment. Ultimately, 4 articles met all criteria.

Data synthesis involved analysing the selected articles to provide an overview of the relationship between serious games and critical thinking dispositions. Given the review’s nature, a risk of bias assessment was not applicable. Ethical considerations were ensured by selecting peer-reviewed articles meeting academic standards. A comprehensive analysis included synthesising findings, assessing different models, identifying common themes, and exploring theoretical underpinnings. This approach facilitated an in-depth exploration of the intricate relationship between serious game design and critical thinking dispositions.

3. Results

To comprehensively address the relationship between serious game design and the development of critical thinking disposition, this section presents the results of the systematic literature review. The results are organised into several sub-sections for clarity and coherence.

3.1. Descriptive Analysis of the Selected Studies: An Overview

The analysed articles encompass a wide range of topics, including serious games across various educational disciplines such as accounting, political science, and language learning, catering to individuals ranging in age from adolescents to adults (Table 1). These studies highlight the evolving role of serious games in enhancing usability, engagement, and educational efficacy. They span from practical methodologies for integrating games into online pedagogy to theoretical models for game design and assessment, underlining the increasing complexity and significance of serious games in contemporary education.

Table 1: Summary of Included Studies.

Study	Methodology	Instrument	CTD Dimensions Measured	Demographic	Duration of the Game	Results
Yi (2011)	Empirical: Experimental before and after design	Self-perception questionnaire	(1) Systematicity and analyticity, (2) Open-mindedness, (3) Inquisitiveness, (4) Reflective thinking	Taiwan: college and graduate students	Less than 15 mins	(1) systematicity and analyticity and (2) inquisitiveness are the two factors improved significantly, whereas there are no significant improving in (3) open-mindedness and (4) reflective thinking
Mabrito (2016)	Empirical: Survey	Self-perception questionnaire	Not specified / Not directed measured	USA: First year writing students	Not specified	Players found the game challenging and reported positively that it helped them learn about rhetorical appeals, finding it more engaging than a classroom lecture
Jensen & Dau (2019)	Empirical: case study – s	In-dept interviews and focus group interview	Not specified	Denmark: World of Warcraft gamers and university students from the technology education program	Not specified	The empirical findings reveal how the principles from game-based learning can support the students’ learning process and afford critical thinking and Exploration relevant for higher education.
Yang et al. (2021)	Empirical: experimental before and after design	Self-perception questionnaire	Scepticism	Korea: adults between the ages 20 and 29	10mins	The game effectively enhanced the cognitive aspect of media and information literacy (information discernment skills), but not the attitudinal aspect (scepticism toward online information)

3.2. Relationship analysis

Our first research question asked: What is the relationship between serious games design and the development of critical thinking disposition?

Of the four reviewed empirical studies, three adopted quantitative designs: Yi (2011) employed an experimental approach to investigate the influence of a serious game utilising interactive narratives and argument reconstruction on political efficacy and critical thinking dispositions. Through a before-and-after design, participants firstly completed questionnaires evaluating political efficacy and critical thinking disposition. Following this, participants played the serious game after which they again completed the questionnaires.

Similarly, Yang et al. (2021) examined the efficacy of an online game, Trustme!, in enhancing information discernment skills and scepticism toward online information. Their study involved three groups: one playing Trustme!, another completing a non-game quiz, and a control group. By measuring the impact on scepticism toward online information and information discernment skills, the study found Trustme! to effectively improve the latter but not significantly influence scepticism toward online information.

Contrastingly, Mabrito (2016) adopted a survey design to evaluate the effectiveness of a serious game, Appealia, in teaching rhetorical appeals. Assessing two versions of the game (2D and 3D) among university-level students, the study immediately solicited feedback through surveys post-game engagement, probing perceived learning effectiveness, engagement levels, and overall impact of the game on their understanding of rhetorical appeals.

Furthermore, Jensen and Dau (2019) chose a qualitative case study approach to examine the influence of World of Warcraft principles on critical thinking and exploration in higher education. Employing in-depth interviews and focus group discussions, their study explored the nuanced impacts of integrating gaming principles into educational settings. Noteworthy is the observation that these findings predominantly rely on subjective participant perspectives, such as surveys responses or qualitative interviews. This reliance on subjective data sources raises the potential for bias or limitations in interpretation, warranting careful consideration when analysing the results.

3.3. Design Element and Pedagogical Model Analysis

Our sub-research questions asked: (1) What are the key design elements of serious games that have been linked to the development of critical thinking disposition? and (2) What pedagogical models have been used to frame the role of serious game design in relation to the development of critical thinking disposition?

In analysing the key elements of serious game design across the reviewed articles, a comprehensive understanding of their impact on critical thinking disposition emerges. The four articles collectively highlight several common elements, each of which contributes significantly to the gaming experience. These include: (1) exploration of diverse character perspectives and consequential choices, (2) a scenario-based approach and integration of interactive elements, (3) emphasis on emotion, empathy, and challenge, (4) incorporation of gamification elements such as scaffolding techniques, feedback and rewards, (5) adherence to the psychosocial moratorium principle, and (6) prioritisation of autonomy and player-centric design. Importantly, these elements are intricately interconnected, as elaborated upon in the subsequent discussion.

In all four games examined, a significant thematic element revolves around character perspectives and the consequential choices they face. This aspect plays a pivotal role in shaping the player's experience and the overall narrative trajectory within each game. Mabrito's (2016) game, for instance, immerses players in a first-person, role-playing environment where interactions with non-playable characters (NPCs) hinge on the player's ability to navigate various perspectives. Players must strategically choose dialogue options that align with the ethos, logos, or pathos of each NPC to gain their trust and ultimately influence their decisions. This emphasis on character perspectives underscores the complexity of interpersonal dynamics within the game world. Similarly, Yi's (2011) game integrates character perspectives into its interactive narrative, offering players a multifaceted understanding of the challenges and motivations driving each character. Through engaging with these diverse perspectives, players are presented with meaningful choices that not only impact the storyline but also foster empathy and critical thinking. Yang et al.'s (2021) game takes a unique approach by placing players in the role of social media influencers tasked with discerning the reliability of information presented to them. In this context, character perspectives extend beyond traditional in-game personas to encompass the viewpoints of various sources of information. Players must navigate conflicting perspectives and make informed choices to advance through the game, reflecting real-world challenges in media literacy and critical analysis. Moreover, Jensen and Dau's (2019) exploration of World of Warcraft highlight the player's agency in crafting their own narrative within the game's expansive world. Here, character perspectives are not only inherent to the game's pre-established lore but also shaped by

the player's decisions and interactions with other players. This dynamic demonstrates the intricate interplay between character perspectives and player agency, further enriching the gaming experience.

Closely related to character perspectives, the four games employ a scenario-based approach and interactive narrative elements to engage players. In Mabrito's (2016) game, interactions with NPCs are pivotal, requiring players to utilise various appeals to amass followers and ultimately gain control over a fictional planet. According to the authors, "players must successfully negotiate and understand how to use appeals to ethos, logos, and pathos to advance in game play" (p. 22). Similarly, Yi's (2011) game "integrates E-E into interactive narratives" (p. 155), featuring four characters with differing stances on the Economic Cooperation Framework Agreement. Players can select from three avatars and then choose dialogue options aligned with their avatar's perspective. Within the intertwined narrative, players must discern each avatar's viewpoint to fully comprehend the storyline.

Furthermore, Yang et al. (2021) present a game where "the player is to take on the role of the protagonist and successfully identify the reliability of each piece of information presented on the screen" (p.5). This scenario simulates social media influence, emphasising the importance of discerning trustworthy information. Game mechanics are structured to emulate the process of evaluating and disseminating information on social media platforms. Moreover, Jensen and Dau (2019) assert that "World of Warcraft gives the player the possibility to create and explore their own narrative" (p. 877).

Notably, across all games analysed, a prominent aspect is the integration of emotion, empathy engagement, and challenge. Jensen and Dau (2019) highlight this dynamic by noting that players themselves use the term "iterative development" to describe their progression within the game, emphasising the idea of progress as a manifestation of intensive learning processes. They argue that progress "is an expression of an intensive learning process. It means that progress can be considered a series of sequences of actions that require players to be critical and focused on the challenge" (p. 877). This element of challenge is similarly evident in Yang et al.'s (2011) game, as well as in Mabrito's (2016) and Yi's (2011) games. Mabrito (2016) explores the intricacies of their game, describing it as a "first-person, role-playing game where players negotiate interactions with NPCs in an attempt to gain their following by appealing to them through either logos (logic or reasoning), ethos (credibility or trustworthiness), or pathos (emotion), whichever one would be the most convincing to that particular NPC" (p. 23). Yi (2011) also incorporates elements of entertainment-education, particularly focusing on eliciting emotions. The author emphasises the importance of entertainment in "appeal to emotions, inspire empathy, provide an example of the recommended behavior, persuade the audience that they can carry out the recommended behavior (self-efficacy), and leave them with a sense that the new" (p. 148).

In close connection to the preceding exploration of emotion, empathy engagement, and challenge, the integration of gamification techniques, including scaffolding, feedback, and rewards emerge as a pivotal aspect. Mabrito's (2016) game implementation showcases a deliberate progression in difficulty, encouraging players to incrementally apply their knowledge and adjust their strategies. The game mechanics illustrate this concept vividly: "If a player successfully interprets textual cues and selects the appropriate response among a choice of three, the player has won that follower. If unsuccessful, the player receives one more chance to play that potential follower" (p. 24). The overarching objective, to amass a following and ultimately seize control of the planet, serves as the foundation for the reward system, which revolves around winning followers.

Similarly, Yi (2011) embeds straightforward choices within the game to facilitate players' comprehension of various avatar perspectives in a gradual manner. The game's mechanics incentivize players to heed clues and promptly adjust their perspectives, as failure to do so results in repeated incorrect answers, adversely affecting performance. As articulated by Yi, "if the player chooses the wrong answer the first time but accepts the clues, he/she would switch to the right answer right away. However, if the player does not accept the clues and insists on his/her own perspectives, he/she may click many wrong answers again and again. The more wrong answers he/she clicks, the worse the performance is" (p. 150).

In alignment with the emphasis on feedback, Yang et al. (2021) devised immediate elaborated feedback within their game to foster higher-order learning outcomes. This feedback not only informs players of the accuracy of their responses but also provides insights into task-level and process-level information. Yang and colleagues state that "feedback on the correctness of the player's answers as well as the virtual achievements and rewards given to the player also provide the players with the means to assess their performance and progress" (Yang et al. 2021, p.6). The integration of rewards, such as virtual followers, serves to heighten the safety of

the gaming experience, ensuring that players encounter no real-world repercussions for erroneous choices.

In a similar vein, Jensen and Dau (2019) underscore the iterative and reflective nature of gameplay in surmounting challenges within *World of Warcraft*. They contend that the game's structure empowers players to craft and explore their narratives, fostering the continual evolution of ideas and strategies. As they argue, "the game structure behind *World of Warcraft* gives the player the possibility to create and explore their own narrative when working with games instead" (p. 877). This iterative process underscores the dynamic nature of learning and adaptation within the gaming milieu.

Regardless of the specific game, each of the four mentioned provides individuals with a secure environment for exploration, experimentation, and learning, thus embodying the psychosocial moratorium principle. An incorrect decision may result in consequences such as a loss of followers (Mabrito, 2016; Yang et al., 2021), diminished performance (Yi, 2011), or encountering game mechanisms like "death", "game over" or "wipe" (Jensen & Dau, 2019). Jensen and Dau (2019) elaborate that in *World of Warcraft*, a "wipe" signifies a failure of a group task, prompting a fresh start and thereby fostering progress. They contend that "a wipe involves processes of reflection aiming at developing new ideas by linking facts and suggestions from an experimental situation of proposed solutions" (p. 878). The authors emphasise that at the heart of this phenomenon lies the development of a trial-and-error culture within the game, which effectively connects practical in-game experiences with theoretical insights. Jensen and Dau (2019) highlight that wipes function as a mechanism fostering collaboration among players and refining their gaming tactics. They further argue that each wipe heightens motivation and intensifies focus on the current task, suggesting that wipes are viewed as fundamental game activities like other recurring in-game tasks.

Overall, the examination of these elements suggests a common thread of autonomy and player-centric design. This notion is particularly emphasised by Jensen and Dau (2019), where they assert that in *World of Warcraft*, "players have a high degree of autonomy, and they extend the topics addressed in the game design in their search for new knowledge" (p. 877). Additionally, it is noteworthy that Mabrito (2016) underscores the impact of immersive graphics, avatars, and sound effects on enhancing player engagement and the learning experience. Mabrito highlights that "in the 3D version, graphics and avatars were added to create a fully immersive game world" (p. 23).

What pedagogical models have been used to frame the role of serious game design in relation to the development of critical thinking disposition?

In exploring the pedagogical models discussed across the articles by Mabrito (2016), Yi (2011), Yang et al. (2021), and Jensen and Dau (2019), a multifaceted landscape emerges, showcasing a variety of strategies aimed at cultivating critical thinking dispositions among learners. These models not only underscore the diversity in educational strategies but also highlight the innovative ways through which serious games can be leveraged to foster critical thinking dispositions. Yi (2011) examines the integration of interactive narratives and entertainment-education within a political simulation game, aiming to enhance political efficacy and critical thinking among college students. Through navigating political scenarios, making policy decisions, and engaging in debates with virtual characters, this approach exemplifies how serious games can facilitate meaningful dialogue and critical reflection on complex issues. Similarly, Mabrito (2016) advocates for the infusion of constructivist learning theories into serious games, illustrating how games rooted in these principles can create environments where learners actively construct knowledge through exploration and interaction. Yang et al. (2021) also concentrate on incorporating problem-solving and inquiry-based learning within a science education game, showcasing how serious games can establish dynamic learning environments that foster critical thinking through inquiry, experimentation, and reflection on decision-making consequences.

In addition to advocating a core constructivist approach, Jensen and Dau (2019) propose a comprehensive framework for game-based learning design that emphasises constructive alignment, problem-based learning, and adaptive learning environments. This framework is vividly illustrated through a specific game that aligns its learning objectives seamlessly with gameplay activities and assessments. By tailoring the learning journey to the individual player's skill level, the game provides a personalised experience while fostering critical thinking through immersive encounters with real-life dilemmas.

These examples illustrate the multifaceted nature of pedagogical models in serious game design, highlighting the potential of games as powerful tools for enhancing critical thinking dispositions. Through constructivist learning, interactive narratives, problem-solving, and inquiry-based approaches, serious games

can offer immersive and engaging learning experiences that challenge learners to think critically, reflect on their decisions, and engage with complex problems in innovative ways.

4. Discussion and Conclusions

This study aimed to investigate the relationship between serious games design and the cultivation of critical thinking disposition, an area notably understudied in the academic landscape. This lack of attention may stem from the inherent challenges of nurturing and assessing critical thinking disposition, including issues such as disagreement regarding its dimensions and the inadequacy of assessment tools. Furthermore, the complex nature of critical thinking disposition, which involves various behavioural patterns across different thinking scenarios, makes cultivating and measuring it demanding and time-consuming.

Findings from Yi (2011) indicated significant enhancements in systematicity, analyticity, and inquisitiveness, but no notable improvements in open-mindedness and reflective thinking. Similarly, Yang et al. (2021) reported advancements in cognitive aspects but minimal impact on dispositional aspects, possibly due to time constraints from short gameplay sessions. Of the four games studied, two had gameplay durations of less than 15 minutes, while information was unavailable for the remaining two. This observation raises concerns, particularly considering that critical thinking, especially its dispositional aspect, requires time and practise to mature (Archila et al., 2022). However, it is noteworthy that shorter durations may be more effective for some dimensions of critical thinking disposition than others.

Consequently, inquiries arise regarding the efficacy of brief gameplay sessions in fostering critical thinking disposition among students. While this observation does not necessarily imply that games should be longer or that shorter sessions are ineffective, it underscores the potential insufficiency of a single playthrough in fully nurturing critical thinking disposition. This highlights the necessity of employing diverse techniques to effectively contribute to the development of critical thinking disposition among students (Halpern, 2014). Importantly, it is imperative to consider the methodological approach employed in measuring dispositional aspects. Although self-perception provides valuable insights, its efficacy may be subject to questioning. Thus, future research endeavours should explore alternative methodologies that provide deeper insights and objectivity in evaluating the dispositional components of critical thinking.

Despite limitations, this research has identified key elements and pedagogical models relevant to developing critical thinking disposition within serious games. Consistent with prior research, these elements encompass the exploration of diverse character perspectives and consequential choices, allowing for personalised experiences tailored to each student's needs and preferences (Ravyse et al., 2017). They also involve challenging cognitive biases and broaden viewpoints (Whitby, Deterding, & Iacovides, 2019). Additionally, the incorporation of the illusion of virtual body ownership (Cmentowski et al., 2023), gamification elements such as choice, challenge, and feedback (Abt, 1970), adherence to the psychosocial moratorium principle (Gee, 2003), and prioritisation of autonomy and player-centric design (Annetta & Cheng, 2008) are identified as crucial factors.

Interactive elements in video games enable players to explore various scenarios, perspectives, and options (Cmentowski et al., 2023), thereby contributing to the development of critical thinking disposition. Moreover, challenges embedded within games that require critical thinking skills, such as logic, reasoning, creativity, and problem-solving, likely further enhance this development. Furthermore, gamification techniques provide structure and guidance, while the psychosocial moratorium principle fosters a supportive learning environment (Gee, 2003). When applied to serious games, the psychosocial moratorium principle suggests that these games offer users a platform to engage in learning and problem-solving activities, allowing them to take risks, make mistakes, and derive insights from their experiences within a controlled setting. Consequently, these games may facilitate learning and development while mitigating potential negative consequences that individuals might encounter in real-world scenarios. Prioritising player autonomy encourages self-directed learning, which can, in turn, foster the development of critical thinking. This is particularly significant, as previous scholars have conceptualized autonomy as closely linked to critical thinking (Wang et al., 2024; Wang et al., 2023).

Moreover, the discussion around personalised learning, as proposed by Jensen and Dau (2019), highlights the importance of balancing personalised and communal learning experiences in educational game design. Integrating communal and exploratory elements alongside personalised content can foster critical thinking by exposing learners to diverse perspectives while maintaining engagement.

In summary, this analysis marks a crucial stride toward comprehending the intricate link between serious game design and critical thinking development. By unpacking these complexities, our research aims to inform effective game design for nurturing critical thinking, advancing educational goals, and benefiting society. Integrating diverse pedagogical models into serious game design fosters interactive, learner-centred experiences, enhancing critical thinking and preparing learners for the challenges of the modern world. As the field progresses, these insights will guide educators, designers, and researchers in leveraging games for educational enrichment.

5. Limitations and Future Research Directions

While this systematic review has highlighted the multifaceted impact of serious game design on critical thinking dispositions, it is important to acknowledge its limitations. The choice to adopt an exploratory approach rather than empirical analyses like meta-analysis was informed by the limited availability of comparable articles in the existing body of literature. Future research endeavours should aim to fill this gap by conducting empirical investigations on the relationship between serious games and critical thinking development, including exploring the potentially different impacts of serious game design on different elements of critical thinking disposition as a function of time, subject type and educational level.

Moving forward, future research should explore longitudinal effects, discipline-specific impacts, and tailored approaches in serious game development for enhancing critical thinking dispositions. Equally important is an in-depth analysis of the disadvantages of this type of practice. Significant challenges include the resource-intensive nature of serious game development, which often requires substantial time, funding, and expertise. Additionally, there is the concern of misaligned priorities, where the emphasis on gamification can overshadow critical thinking goals, and the persistent problem of unequal access to technology, which can increment educational inequities. Moreover, it is crucial to emphasize how these serious games are implemented within emerging virtual spaces, such as the Metaverse or AI-driven platforms, to ensure they uphold user privacy and data protection, particularly safeguarding the rights of young children (Johnston, Wilson, & Derrell, 2024). Addressing these barriers is critical, not only to optimise the effectiveness of serious games but also to ensure their ethical equitable and meaningful implementation. Investigating how such challenges can be systematically addressed, therefore, would be a valuable direction for future research. Importantly, collaboration between educators and video game designers is essential to ensure that serious games align with educational objectives and pedagogical principles, leading to the creation of more effective and engaging educational tools.

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