Embedding Reflective Game Design (RGD) into Digital Game Based Learning: Design Recommendations and Empirical Insights

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Abstract: Reflective learning enhances critical thinking, metacognition, and knowledge retention by encouraging learners to analyse their experiences. Digital games provide a rich environment for reflection through interactivity, feedback, and iterative exploration. While many games incorporate elements that support reflective learning, such as prompts, feedback displays, and decision-making mechanics, there has been limited systematic integration of reflective principles into digital Game-Based Learning (GBL) design. This study provides a structured Reflective Game Design (RGD) approach to embed reflective learning into digital GBL environments. Conducted in three phases, the research: (1) reviewed literature to identify core reflective strategies and game mechanics; (2) co-designed and developed two game prototypes, one with RGD features and one without; and (3) used a mixed-methods evaluation to compare usability, engagement, and learning outcomes across the two versions. Findings indicate that games designed with RGD features significantly enhance learners' critical engagement, emotional awareness, and knowledge retention. Features such as journaling, prompts, feedback systems, and emotional tracking, were particularly effective in deepening player connection and learning. This research offers actionable design recommendations and a flexible RGD framework to support the integration of reflective practices into educational games. It will be of particular value to GBL researchers, instructional designers, serious game developers, and educators seeking to create more meaningful, learner-centred digital experiences.

Keywords: Game-Based learning, Digital educational games, Reflective game design, Metacognition, Participatory design, Serious games

1. Introduction

Game-Based Learning (GBL) uses the motivational power and interactivity of digital games to support knowledge acquisition and skill development (Gee, 2004; Kapp, 2013). As educational technologies evolve, GBL environments increasingly incorporate learning theories to deepen engagement and understanding (Klopfer et al., 2009; Prensky, 2001; Takeuchi & Vaala, 2014). Reflective learning, in particular, promotes metacognition, critical thinking, and long-term behavioural change (Mezirow, 1994). Digital games are well suited to support reflection through their decision-driven, feedback-rich structure (Khaled, 2018). Features such as branching narratives and consequence-based choices naturally prompt introspection. Yet few games systematically apply reflective principles in their design (Shaheen & Fotaris, 2023).

This paper introduces the Reflective Game Design (RGD) framework, developed through a three-phase study combining theoretical analysis, participatory design, and evaluation. The aim is to offer actionable recommendations for educators, researchers, and game designers seeking to enhance the reflective capacity of GBL environments.

1.1 Reflective Learning in Education

Reflective learning involves critically examining one's experiences to gain insights that inform future actions (Dewey, 1933). It enhances metacognition, supports problem-solving, and fosters self-awareness by prompting learners to question assumptions, identify patterns, and explore alternatives (Mezirow, 1994; Schön, 1983).

Dewey describes reflection as active, persistent inquiry that moves beyond memorisation to interpretation and application. Schön (Schön, 1983) distinguishes between two modes essential for self-regulated learning: 1) Reflection-in-action, occurring in the moment to help learners adjust behaviours in real-time; and 2) Reflection-on-action, which occurs retrospectively to evaluate past decisions. Effective reflection also includes emotional and behavioural engagement, requiring learners to reassess motivations and emotional responses to drive change (Fleck and Fitzpatrick, 2010). Structured methods (such as journals, scenario analysis, and feedback) are widely used in education, from teacher training (Loughran, 2002) to healthcare (Mann et al., 2009) and workplace learning (Eraut, 2004).

In digital environments, these tools can be reimagined through dynamic feedback, in-game prompts, and visual progress indicators. However, integrating reflection without disrupting gameplay remains a key design challenge. As this paper argues, serious games offer an untapped opportunity to address that challenge.

1.2 Reflective Learning in GBL Design

Digital GBL environments provide immersive, interactive spaces that support experiential learning through feedback, simulation, and trial and error (Gee, 2004; Kapp, 2013) (Fotaris & Mastoras, 2019). These conditions align well with reflective learning. Yet in most educational games, reflection is incidental, not purposefully designed. To address this, Lin et al. (1999) outlined four adaptable strategies: process displays that visualise learning pathways; prompts that pause gameplay to ask players to justify choices; process models offering idealised comparisons; and social discourse through peer feedback. Sengers et al. (2005) expanded these into a Reflective Design framework that disrupts assumptions and fosters introspection. Khaled (2018) applied these principles to games, advocating for intentional disruption and self-reflection, even at the cost of immersion.

Reflective features can take many forms: emotion-tracking heads-up displays (HUDs), in-game journals, moral dilemmas, or post-level debriefs. Role-play and narrative immersion further support reflection by encouraging players to explore unfamiliar perspectives (Klopfer et al., 2009). Building on this, Khaled et al. (2024) presented "Reflective Surfaces" as an interactive game-as-research format where designers' reflective practices are explored through navigable desktops. They argued that tacit, practice-based knowledge can be better expressed through playful, digital forms rather than traditional academic style. The paper call for rethinking, how design research is articulated, reviewed, and shared to make knowledge forms suitable for their function. In GBL, Shaheen et al. (2023) investigated the efficacy of RGD by integrating features such as process displays, prompts, HUDs, UI elements, and reflective comparisons. The RGD approach and game prototype received positive feedback for engagement, content clarity, incorporation of reflective elements, and player immersion. Despite, these opportunities though, few games systematically integrate reflection into core design. The Reflective Game Design (RGD) framework introduced in this paper offers a research-based methodology to address this gap through iterative, learner-centred design.

2. Literature Review

While the theoretical case for embedding reflection in digital games is well established, its practical implementation remains inconsistent. Frameworks by Lin et al. (1999) and Khaled (2018) provide guidance, yet few educational games scaffold multiple levels of reflection, especially the deeper forms identified by Fleck and Fitzpatrick (2010), such as dialogic, transformative, and critical reflection. Even basic features like prompts, process displays, and structured feedback can enhance learner engagement and critical thinking. However, these are often deployed in isolation and lack integration into broader design systems. This section reviews key efforts to embed reflection in GBL and highlights recurring design tensions and gaps.

Kiili (2005) Experiential Gaming Model was an early attempt to integrate reflective feedback, but its emphasis on maintaining player flow often constrained deeper metacognitive engagement illustrating the persistent trade-off between immersion and reflection. The MIRROR Project (Pannese et al., 2012) used post-task feedback to promote on-action reflection in workplace learning. Though not designed for formal education, its use of game-informed strategies to trigger emotional insight shows the cross-domain potential of reflective design.

In education, Maram et al. (2024) developed Open Learner Models (OLMs) to support in-action reflection in classrooms through a visualisation system that helps students identify conceptual errors and explore alternative board states to enhance learning. They created the game "Ah! I See", which used OLMs to facilitate both in-action and on-action reflection. This work later evolved into a game-based version that integrated real-time and retrospective reflection using analytics and visualisation.

Reflective design has also been explored in immersive and IoT-enhanced settings. Huang and Ng (2020) applied Fleck and Fitzpatrick's framework in a museum-based game using sensor-driven interactions to promote critical reflection. Urwin and Flick (2019) used Augmented Reality (AR) to support mental health reflection, while Fiala et al. (2020) employed Virtual Reality (VR) simulations and interviews to support post-experience analysis in workplace safety.

Despite these advances, the field lacks a generalisable methodology for reflective GBL. Most implementations remain tied to specific tools, genres, or contexts. A unified set of heuristics is needed to help developers embed reflection more systematically. This study responds by proposing research-informed design principles to guide reflective GBL development.

3. Research Methodology

This study explored how RGD can enhance the educational impact of digital GBL and aimed to generate actionable design recommendations. It adopted Thinking (Dunne et al., 2006) and Human-Centred Design (ISO 9241-210:2019), both of which emphasise iterative development and sustained user involvement. A mixed-methods approach integrated the generalisability of quantitative data with the depth of qualitative insights. The research unfolded in three interconnected phases:

- Phase 1 - Foundation: Adapt reflective learning practices to inform digital GBL design.
- Phase 2 - Design and Iteration: Co-design and refine a digital GBL prototype with RGD features.
- Phase 3 - Evaluation: Assess the impact of RGD on usability, engagement, and learning outcomes, leading to design heuristics.

Participants were young adults aged 18-24, selected for their familiarity with digital games and interactive systems as these traits align with GBL's target users. Ethical approval was obtained via the Brighton Research Ethics Application Manager, with informed consent from all participants.

3.1 Phase 1: Foundation

This phase established the theoretical foundation for the RGD framework by mapping reflective practices onto game mechanics that support metacognitive engagement. Based on prior work (Shaheen et al., 2021) and frameworks by (Lin et al., 1999), (Kolb, 1984), and (Khaled, 2018), the RGD model was developed as an iterative, feedback-driven system. As shown in in Figure 1, reflective elements such as prompts, emotion tracking, and dynamic feedback are embedded throughout the player experience, making reflection a core gameplay component rather than a supplementary feature.

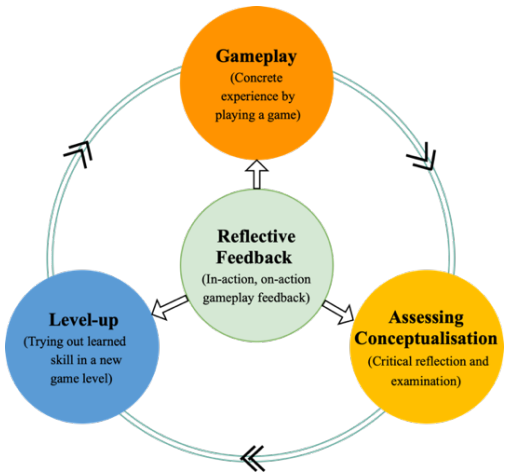


Figure 1: The RGD Framework, illustrating how reflective feedback is embedded across all stages of player interaction (Shaheen et al., 2022)

To ensure real-world relevance, the research team conducted surveys (N = 101) and interviews (N = 15), followed by thematic analysis (Shaheen & Fotaris, 2023). While participants showed limited awareness of serious games as educational tools, they linked digital games to problem-solving, critical thinking, and emotional awareness. These findings, along with user preferences for logic-based gameplay and minimalist UI, directly informed the mechanics and design strategies used in the next phase.

3.2 Phase 2: Design and Iteration

This phase translated theoretical insights into a practical game prototype using a Design Thinking approach. The aim was to create a user-centred experience addressing the reflective needs of young adults (18–24), with Phase 1 findings guiding the integration of narrative, mechanics, and learning objectives. Subject matter experts reviewed the prototype to ensure alignment with emotional and cognitive goals.

Co-design sessions (N = 6), based on participatory design principles (Agbo et al., 2021), informed an initial low-fidelity paper prototype (Walker et al., 2002), refined through two rounds of feedback (N = 25; N = 15) (**Figure 2**). Participants provided input via surveys, questionnaires, and interviews, shaping both content and interface elements for usability and relevance.

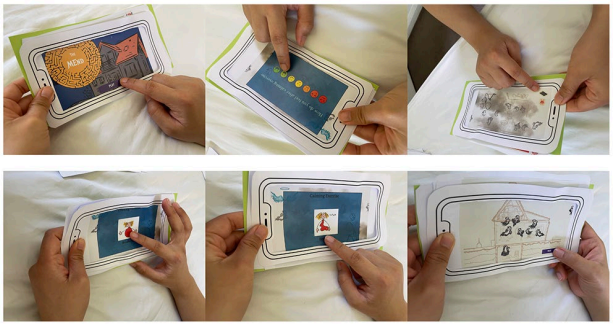
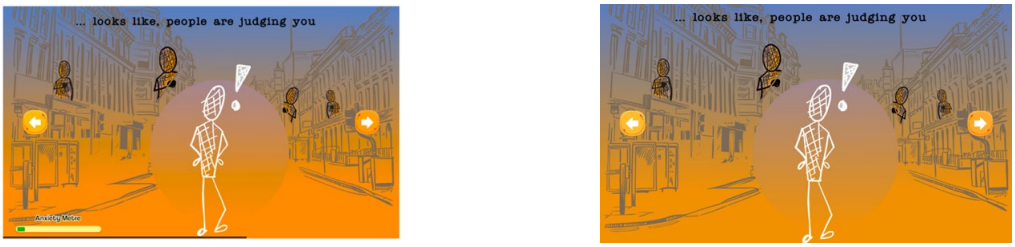
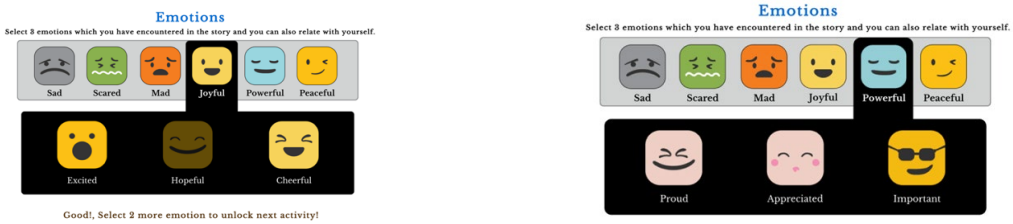


Figure 2: Paper prototype testing (N=25)

This process led to two digital prototypes for comparative testing in Phase 3: one with RGD features and one without. The game, The Mend, uses a home renovation metaphor to explore emotional resilience. Players face social and familial pressures personified as anxiety-inducing "daemons" in a deteriorating house, while a guardian angel (symbolising inner consciousness) guides them through puzzles and narrative choices. **Figure 3** illustrates how RGD features enhance the experience compared to the non-RGD version.



(a) Narrative scenes with and without reflective indicators (e.g., anxiety meter).



(b) Emotional choice activities with and without visual feedback.

(c) Breathing exercises using HUD elements for pacing and emotional state tracking.

Figure 1: Comparison of RGD and non-RGD gameplay elements in The Mend

The RGD prototype also included additional tools to promote deeper reflection and emotional awareness. These features are shown in **Figure 4** and include: (a) A diary system for tracking emotional states over time; (b) Reflective HUDs embedded at key decision points; (c) Process prompts providing feedback to support metacognitive engagement.

(a) Diary showing the reflective comparison (process model) of the player feelings.

(b) Reflective HUDs

(c) Reflective feedback in the form of process prompts

Figure 2: Reflective elements in the RGD prototype supporting player reflection and emotional tracking

3.3 Phase 3: Evaluation and Recommendations

In the final phase, two high-fidelity web-based prototypes, one with RGD elements and one without, were evaluated to assess the impact of reflective game design on learning outcomes in digital GBL. The evaluation had two key aims: i) to compare engagement, usability, and perceived learning between the RGD and non-RGD versions (Shaheen et al., 2023); ii) to measure the effect of RGD features on actual learning outcomes and knowledge retention (Shaheen & Fotaris, 2024)

A comparative mixed-methods study (N = 69) was conducted using pre- and post-test questionnaires. Results showed that participants using the RGD version demonstrated significantly higher learning gains and retention than those using the non-RGD version, supporting the hypothesis that structured reflective features can enhance educational impact. Participants highlighted the RGD prototype's ability to promote critical thinking, emotional awareness, and personal reflection. Some areas for improvement were also noted, including visual aesthetics and narrative pacing. Insights from this phase informed further refinement of the RGD framework, resulting in a set of practical heuristics and design recommendations for integrating reflection into future digital learning games.

4. RGD Recommendations

The following recommendations were derived from iterative design research, user testing, and co-design sessions, offering a structured framework for integrating reflective learning into digital gaThe heuristic statements for recommendations are defined by Van den Akker (1999) as if you want to design intervention X [for the purpose/function Y in context Z], then you are best advised to give that intervention the characteristics A, B, and C [substantive emphasis], and to do that via procedures K, L, and M [procedural emphasis], because of arguments P, Q, and R.

4.1 Utilise the RGD Framework for Iterative Reflective Design

Recommendation: If a game designer aims to integrate reflective design effectively for the purpose of enhancing reflective learning in the context of digital games, then they are best advised to utilise the Reflective Game Design (RGD) framework and iterate on the design of game activities, and to do this through continuous feedback, user testing, and iterative improvements, because doing so ensures that the reflective elements are effectively integrated and refined based on player experiences and feedback.

The presented RGD framework offers a structured and an iterative process model that helps incorporating reflective features into digital GBL.

The following are the key strategies to implement RGD framework effectively:

- Structured Approach: it helps to adopt a systematic process to incorporate reflective feedback into game mechanics, narratives, and activities.
- Flexible Adaptation: The iterative nature of this framework enables designers to integrate reflective feedback cycles to improve the reflective elements based on player experiences.

- Educational Value: As this framework offers to add concrete experience, critical reflection and using newly acquired skills in a new level. Therefore, designing a GBL through this framework encourages and enhance reflective thinking and educational value.

4.2 Foster Empathy, Respect, and User Involvement

Recommendation: If a game designer, whether focused on digital GBL or entertainment games, intends to create a reflective design intervention, they are advised to prioritise fostering respect and empathy towards its users. Furthermore, involving users in the design process to establish trust and foster confidence in players' reflective abilities is crucial. Additionally, the design should emphasise promoting self-respect within the game by valuing players' beliefs, actions, feelings, and identities. To achieve this, integrating mechanisms that consistently reinforce these values throughout gameplay is essential. This comprehensive approach creates a supportive and inclusive environment favourable to effective reflective learning.

This recommendation suggests that empathy-driven design enhances both player immersion and reflective learning, as supported by feedback from co-design sessions. Engaging users actively throughout development builds trust and fosters a supportive environment conducive to reflection.

The following are the key Strategies:

- Co-Design: Involve players early and continuously via focus groups, surveys, and playtesting to incorporate their perspectives and enhance user-centred design.
- Empathetic Narratives: Create diverse characters and storylines that model respect and understanding, encouraging players to relate and reflect on different viewpoints.
- Self-Respect Mechanics: Integrate gameplay elements that reinforce positive player choices and promote self-respect through meaningful feedback, such as consequences linked to decisions.

4.3 Balance Reflective Elements and Game Design Components

Recommendation: If a game designer, whether focused on digital GBL or entertainment games, intends to incorporate a reflective design for the purpose of fostering reflective learning, then they are best advised to ensure that it gives reflective feedback using process prompts/displays, process models, in-action, on-action, and social discourse, and to achieve a balance in terms of game complexity, game activities, HUDs, UI, and learning assessments, and to do this through structured feedback mechanisms, iterative design adjustments, and user-centred evaluation, because doing so promotes a supportive and immersive environment favourable to reflective learning.

A balanced game design prevents cognitive overload and maintains player engagement while supporting meaningful reflection. By thoughtfully integrating reflective feedback and managing game complexity, designers can create immersive experiences conducive to deeper learning. The following are the key Strategies:

- Structured Feedback: Implement reflective journals, prompts at the end of levels, and real-time feedback mechanisms to guide player reflection throughout gameplay.
- Balanced Complexity: Design gameplay that alternates between challenging tasks and reflective pauses, allowing players to consolidate learning without feeling overwhelmed.
- Diverse Assessments: Use a variety of evaluation methods such as quizzes, narrative-driven choices, and puzzles to comprehensively assess reflective understanding and learning outcomes.

4.4 Support Emotional Engagement and Mindful Reflection

Recommendation: Foster emotional engagement and mindfulness through compelling stories, reflective pauses, and intuitive design. These elements deepen metacognitive insight and personal resonance. Games that evoke tension, vulnerability, or moral ambiguity can prompt players to examine values and emotions. When paired with clarity, mindfulness techniques allow players to process these experiences with intention. Key strategies include:

- Reflective Prompts: Introduce deliberate pauses in gameplay, such as journal entries, self-evaluation tools, breathing exercises, or reflective dialogues, to encourage introspection on decisions, emotions, and evolving perspectives.
- Emotionally Charged Narratives: Craft arcs involving growth, challenge, and complex choices. These narratives invite players to emotionally invest and reflect on personal parallels.

- Emotional Intelligence Systems: Create mechanics that simulate social interactions, requiring players to navigate empathy, resolve interpersonal conflicts, or interpret emotional cues. Use feedback tools to prompt players to reflect on their relational choices and internal responses.
- Clarity in Design: Ensure interfaces and objectives are intuitive to minimise cognitive friction and enhance focus.
- Offer Immediate, Reflective Feedback: Use consistent visual or auditory cues, such as animations, sound effects, or HUD indicators, to reinforce reflection and support behavioural awareness during gameplay.

4.5 Encourage Authentic Growth and Real-World Transfer

Recommendation: Promote reflection that leads to personal and professional development by simulating realistic dilemmas and enabling players to track their emotional or ethical growth over time. Reflective games gain relevance when players can apply insights beyond the screen. Simulating professional, social, or emotional challenges strengthens the transfer of learning. Key strategies include:

- Progress Tracking: Use visual dashboards, experience logs, or reflective journals that help players monitor their development over time, reinforcing a sense of growth and self-efficacy.
- Authentic Role-Play: Design narrative challenges based on real-world decisions, professional dilemmas, or social situations. These prompt introspection and cultivate transferable insights into behaviour, judgment, and identity.
- Social Reflection: Support peer engagement through discussion forums, cooperative gameplay, or structured feedback loops. Community-based reflection promotes dialogue, broadens perspectives, and strengthens the reflective process.

4.6 Use Disruption to Spark Insight

Recommendation: Incorporate design elements that disrupt player expectations to stimulate critical thinking and reflection. This includes surprising narrative turns, ambiguous moral choices, or sudden shifts in gameplay. Disruption challenges assumptions and provokes deeper engagement. When paired with follow-up reflection, it helps players reassess their actions and emotional responses. Key strategies include:

- Dynamic Challenges: Introduce unexpected narrative developments, shifts in perspective, or changes in mechanics to surprise players and provoke deeper engagement.
- Structured Reflection After Disruption: Pair disruptive events with follow-up reflection opportunities, such as journaling, dialogue choices, or adaptive feedback, to guide post-event introspection.
- Varied Game Structures and Environments: Avoid repetition by regularly introducing new mechanics, locations, or character interactions. Novelty sustains curiosity and cognitive stimulation.
- Ethical Ambiguity: Present decisions with no clear right answer to encourage introspection and discussion about values and consequences.

5. Discussion

This study reinforces the value of embedding reflective learning into digital GBL through the RGD framework. Findings suggest that digital games can support metacognitive development by translating established reflective practices into interactive, system-mediated experiences. The three-phase methodology (comprising theoretical grounding, co-design, and comparative evaluation) produced a set of actionable design principles for integrating reflection into both educational and entertainment-focused games.

Rather than treating reflection as a separate or post-hoc activity, the RGD approach embeds it directly into core gameplay. This addresses a common shortcoming in earlier models, where opportunities for reflection were disconnected from player actions. Participant feedback highlighted how features such as reflective HUDs, process prompts, and emotion-tracking interfaces encouraged greater awareness of emotional and cognitive states during play.

Despite these promising outcomes, the study has limitations. While four reflective mechanisms were initially proposed (process prompts, process displays, process models, and social discourse) only the first three were implemented in the prototype. The role of social discourse in fostering collaborative reflection, peer learning, and emotional resonance remains an important area for future exploration. Incorporating structured in-game discussions or multiplayer decision-making scenarios could address this gap.

Additionally, while the comparative design demonstrated improved reflection and learning outcomes, it did not isolate the specific effects of individual reflective features. Future research should examine the standalone and combined impacts of these elements to better understand their respective contributions. Longitudinal studies with more diverse participant samples would also strengthen generalisability, particularly regarding the long-term effects of RGD on critical thinking, retention, and personal development.

This study focused on digital formats, but the underlying heuristics may also apply to non-digital experiences such as board games or tabletop role-playing. These formats offer strong narrative and social components that could support reflection in different but complementary ways. Similarly, future work could explore how RGD principles operate in entertainment games not explicitly designed for learning, where player engagement with emotionally charged or ethically complex content may provide a natural entry point for reflection.

In conclusion, this research contributes to a growing field focused on the intersection of reflective learning and GBL. The RGD recommendations offer a flexible, actionable framework that can inform the design of more meaningful, interactive gameplay to have a positive impact on GBL. Continued research, refinement, and cross-context application will be essential for advancing both the theoretical understanding and practical integration of reflection into digital learning environments.

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