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From Points to Insight: Gamifying Reflective Thinking in Design Education

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Abstract. *Reflective practice in design education is often marginalized as a post-hoc evaluative task rather than conceptualized as a central creative and epistemic process. In this study, reflective practice is reconceptualized as a gamified learning framework that fosters metacognition, visual empathy, and self-awareness through interactive design strategies. The primary objective was to examine the extent to which gamification elements, including feedback cycles, progress visualization, and reward structures, enhance concept retention, reflective insight, and comprehension of design processes among 36 undergraduate graphic design students. Using a mixed-methods, design-based research approach, data were collected across three iterative learning cycles through digital activity logs, reflective journals, and semi-structured interviews. Quantitative analysis using paired-sample t-tests revealed a statistically significant 18% improvement in reflective accuracy and a 20% increase in conceptual retention ($p < 0.05$) following the implementation of gamified reflective activities. Platform analytics further indicated a 92% task completion rate, suggesting increased learner engagement associated with visual feedback and reward mechanisms. Qualitative thematic analysis identified three interrelated dimensions of reflective learning: emotional resonance, sensory awareness, and social connectedness, highlighting the multidimensional nature of reflection in gamified environments. Overall, the findings suggest that gamified reflection can support more active and emotionally engaging learning processes, positioning reflective practice as a form of "learning through play" and offering a pedagogical framework to enhance empathy, self-awareness, and reflective thinking in visual design education.*

Keywords: *Gamification, Reflective Thinking, Design Education, Metacognition, Creative Awareness*

INTRODUCTION

Within dominant approaches to twenty-first-century design education, reflective practice is frequently positioned as a supplementary or evaluative activity rather than as a generative component of the creative process itself (Silalahi et al., 2024). Many design curricula continue to prioritize aesthetic outcomes and technological proficiency, often relegating reflection to post-production assessment (Alt et al., 2022). As a result, students tend to privilege visual execution while underexamining the cognitive and affective dimensions that inform their design decisions. This separation limits students' ability to recognize how visual choices communicate conceptual meanings, cultural positions, and affective experiences, a limitation that has been widely noted in design pedagogy research (Orakcı, 2021). In contrast, (Cross, 2001) conceptualizes reflection as an intrinsic mode of designerly knowing through which meaning, intention, and purpose are actively constructed rather than retrospectively justified.

Recent pedagogical developments emphasizing experiential and learner-centered education have renewed attention to reflection as a process of self-awareness and empathy within design thinking. Within this context, gamification has been explored as a means of transforming reflection from a passive requirement into an interactive learning experience. By incorporating

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structured feedback loops, progress visualization, and reward systems, gamified environments have been shown to support motivation, sustained engagement, and self-regulated learning processes (An, 2020; Hamari et al., 2023; Rivera & Garden, 2021; Saleem et al., 2022). Systematic reviews further suggest that gamification can shift classroom practices from static participation to more dynamic and cognitively active forms of learning (Khaldi et al., 2023; van Gaalen et al., 2021). However, much of this literature focuses on engagement outcomes rather than examining how gamification reshapes reflective depth and epistemic understanding in design contexts.

Despite the growing interest in reflective and critical writing pedagogies, students often continue to experience reflection as an obligatory task rather than as a meaningful pathway to insight. Conventional practices such as end-of-project journals or instructor-led critiques frequently emphasize descriptive recounting over analytical sense-making, resulting in limited transfer of reflective knowledge to future design projects (An, 2020). This tendency restricts the development of metacognitive awareness and reduces opportunities for affective investment in the design process. As noted by (Hollingshead et al., 2022)pedagogical innovation frequently outpaces the availability of empirical evidence, underscoring the need for research examining how alternative reflective models operate in authentic learning environments. In particular, there remains a lack of empirically grounded studies that investigate reflection as an active, emotionally situated process rather than a procedural requirement.

Addressing this gap, the present study reframes reflection as a dynamic and inquiry-driven practice supported by gamified learning structures. Rather than treating reflection as a retrospective justification of outcomes, gamified features such as progression tracking, immediate feedback, and adaptive rewards are employed to encourage sustained analytical and affective engagement. Prior studies suggest that such mechanisms can support the integration of cognitive reasoning with emotional awareness, enabling learners to engage more deeply with the social and affective dimensions of creative work (Cotter et al., 2025; Dogham et al., 2025). In alignment with broader discussions on digital learning environments, (Combs, 2024) emphasizes that increasingly complex technological systems require pedagogical models that prioritize reflexivity and emotional intelligence alongside technical competence. This perspective positions gamified reflection as a response to contemporary demands within design education rather than as a purely motivational strategy.

The primary objective of this research is to examine the extent to which gamified reflective learning enhances metacognitive engagement, conceptual retention, and empathic understanding among graphic design students. Employing a Design-Based Research (DBR) approach, the study

investigates how specific gamification elements namely progress tracking, real-time feedback, and structured rewards shape students' reflective practices across iterative learning cycles. The analysis focuses on changes in reflective quality, learner motivation, and students' awareness of their own cognitive and affective design processes, drawing on established gamification and learning theory (Hamari et al., 2023). By situating reflection within a framework of cognitive play rather than assessment compliance, this study contributes empirical insight into how reflective depth can be cultivated in design education.

This paper contributes to design education research by addressing a critical gap between gamification studies focused on engagement and reflective learning research centered on epistemic development. It advances a pedagogical perspective in which reflection is understood as an emotionally and cognitively meaningful activity shaped through interactive systems rather than static protocols. Building on metacognitive and affective learning theory, the study supports the view that meaningful reflection emerges through active sense-making and emotional involvement rather than adherence to formalized procedures (Fleur et al., 2021; Kuhn, 2022). By positioning gamified reflection within the learning ecology of design education, this research offers a theoretically grounded and empirically informed framework for rethinking reflective practice in visual and digital learning environments. The following section reviews relevant literature on gamification, reflective learning, and metacognitive awareness to further situate the study within this theoretical landscape.

LITERATURE REVIEW

A. Gamification in Design Education

Recent scholarship has examined gamification as a pedagogical strategy capable of reshaping learning environments by introducing structured interaction, feedback, and progression systems. Studies indicate that gamified learning designs can support learner engagement and sustained motivation across higher education contexts, particularly when aligned with cognitive and affective learning goals (An, 2020; Hamari et al., 2023). Within design education, gamification has been explored not merely as a motivational supplement but as a framework that enables iterative exploration, visualization of problem spaces, and experimentation with creative risk-taking (Hassan et al., 2021; Okada et al., 2022). However, much of this research foregrounds participation and engagement metrics, while offering limited analysis of how gamification structures influence reflective reasoning and epistemic development in design learning. Reviews of gamified learning further suggest that although adaptive systems may enhance learner involvement, their role in supporting deeper cognitive processes remains under-theorized (Khaldi et al., 2023; Krishnamurthy et al., 2022).

B. Reflective Practice and Metacognition in Design Learning

Reflective practice has long been recognized as a foundational element of designerly knowledge, characterized by an iterative relationship between thinking, acting, and form-making (Cross, 2001). Despite its theoretical importance, reflection within design education is frequently operationalized through post-project evaluations, written critiques, or debriefing workshops that emphasize description over analytical or metacognitive depth (Alt et al., 2022). This limitation is particularly evident in graphic design education, where aesthetic proficiency often receives greater emphasis than the cognitive and affective processes underlying visual decisions (Orakcı, 2021). Recent digital and gamified reflection frameworks suggest alternative approaches that embed reflection within ongoing activity rather than treating it as a retrospective task. Empirical studies further indicate that structured feedback mechanisms and individualized challenges may reduce cognitive overload and make reflective tasks more accessible to learners (Buchner et al., 2022). Nevertheless, existing studies rarely examine how such mechanisms reshape students' awareness of their own thinking processes in design-specific contexts.

C. Affective and Social Dimensions of Reflective Learning

Alongside cognitive considerations, affective and empathetic dimensions have gained increasing attention in research on art and design education. Scholars argue that emotionally grounded reflective processes can enhance metacognitive insight, social connectedness, and moral imagination capacities central to visual communication in human-centered design contexts (Cotter et al., 2025; Dogham et al., 2025). (Rivera & Garden, 2021) emphasize that affective engagement significantly influences whether learners experience reflection as transformative rather than transactional. This shift marks a movement away from viewing gamification as an external motivator toward understanding it as an emotional and intellectual structure that supports reflective inquiry through play, empathy, and exploration. At the same time, the growing presence of AI-augmented design tools has introduced new possibilities for dialogical and mixed-mode reflection, where human creativity and algorithmic feedback intersect (Kim et al., 2022; Ng et al., 2023). Despite these developments, the pedagogical integration of affective and AI-mediated reflection remains largely conceptual within design education literature.

D. Research Gaps and Limitations

Although gamification has been widely investigated in education, healthcare, and organizational learning, its application to reflective thinking and creative empathy in design education remains underexplored. Existing studies predominantly focus on behavioral and motivational outcomes, often overlooking the potential of gamified systems to support

metacognitive awareness and emotionally situated reflection (Krishnamurthy et al., 2022; Rivera & Garden, 2021). Similarly, research on reflective learning in the visual arts frequently relies on verbal or written self-reports, which inadequately address embodied, affective, and sensorial dimensions of cognition (Alt et al., 2022; Dogham et al., 2025). Metacognitive models derived from psychology, while methodologically rigorous, often fail to account for the aesthetic and affective characteristics inherent in visual practice (Fleming, 2025; Fleur et al., 2021). Furthermore, limited empirical attention has been given to the cognitive demands of reflective work in design education, despite evidence that adaptive feedback may mitigate reflection fatigue and enhance focus (Buchner et al., 2022). Collectively, these gaps highlight the need for integrative research examining how gamified feedback, metacognitive processes, and creative empathy intersect in authentic design learning environments.

E. Research Contribution

In response to these gaps, the present study contributes to design education scholarship by proposing a gamified reflective learning model tailored specifically to graphic design education. Unlike prior approaches that conceptualize reflection as either an individual or retrospective activity, this study frames reflection as an interactive, game-based learning experience where cognition, emotion, and imagination converge (Dogham et al., 2025; Kuhn, 2022). Through the integration of progress visualization, immediate feedback, and reward systems, the research examines how playful learning structures may support conceptual retention, creative empathy, and self-awareness (An, 2020; Clark & Mayer, 2024). Drawing on (Okada et al., 2022), reflection is positioned not as a peripheral component but as a central mode of creative cognition that integrates perception, affect, and intentionality. By situating reflective practice within a designerly epistemology (Cross, 2001) and extending it through game-based and AI-facilitated feedback mechanisms (Kim et al., 2022; Ng et al., 2023), this study offers an empirically grounded framework for rethinking reflective learning in contemporary design pedagogy.

METHODS

A. Research Design

The present study employs a Design-Based Research (DBR) framework to investigate how gamification mechanisms support reflective thinking and imaginative empathy within design-oriented learning environments. DBR was selected for its capacity to iteratively connect theoretical constructs to real-world educational practice, enabling the design, enactment, evaluation, and refinement of pedagogical interventions across successive classroom implementations (Hassan et al., 2021; Kuhn, 2022). This methodological stance is consistent with

(Buchanan, 1992) conception of design as a provisional and situated response to complex, human-centered problems that resist linear resolution. By positioning learning interventions as adaptable design artifacts, DBR enables systematic inquiry into how reflective processes evolve through use and iteration.

Reflective learning, similar to design practice, unfolds through cycles of action, feedback, and revision rather than through fixed instructional sequences. For this reason, DBR provides an appropriate methodological structure for examining reflective pedagogy within dynamic classroom contexts. The study was conducted through three iterative DBR cycles consisting of Design, Implementation, and Reflection, allowing sustained observation of student engagement with the gamified reflective learning model over time. Within each cycle, instructional components were revised based on learner feedback, observed interaction patterns, and reflective outcomes. This iterative logic aligns with prior research emphasizing that the effectiveness of gamified learning environments emerges through prolonged interaction and cognitive engagement rather than isolated instructional outputs (An, 2020; Hamari et al., 2023).

B. Participants and Research Context

The study was conducted within an undergraduate Design Thinking course offered by a higher education institution with an established graphic design program**.** An initial cohort of 52 undergraduate students was invited to participate at the beginning of the study**,** reflecting the full class enrollment at the start of the semester. The final analytical sample consisted of 36 undergraduate graphic design majors**,** all of whom completed the full sequence of DBR cycles and associated learning activities. This clarification addresses the previously noted discrepancy in reported participant numbers.

The reduction from 52 to 36 participants resulted from course withdrawal and incomplete participation across all DBR cycles**,** particularly the absence of reflective journals or post-test data required for longitudinal analysis. Only participants who completed all required activities, including pre–post assessments and reflective submissions, were retained for analysis. This inclusion criterion was applied to ensure internal consistency and methodological validity**,** especially for within-participant quantitative comparisons. Participation was voluntary, and all procedures adhered to ethical guidelines for informed consent, confidentiality, and participant autonomy (Ho et al., 2023).

C. Tools and Materials

The primary instructional instrument was a digitally mediated reflective learning environment designed using Adobe XD and Figma. The platform incorporated gamification

features such as progression mechanics, achievement badges, feedback systems, and structured reflective prompts, which were intentionally designed to sustain engagement while maintaining cognitive and reflective depth. Its development was informed by instructional and multimedia learning principles emphasizing usability, coherence, and learner motivation (Clark & Mayer, 2024). The interface design sought to balance aesthetic clarity with functional support for reflective practice.

In addition to the platform interface, image-based reflective cards were provided to support affective self-reflection on design decisions, aligning with neuroeducational approaches that emphasize visual cognition and emotional processing (Fleming, 2025; Fleur et al., 2021). These cards encouraged learners to articulate emotional and empathetic responses alongside analytical reflection. An adaptive feedback mechanism embedded within the platform dynamically adjusted the level of instructional support based on learner progress, drawing on (Rivera & Garden, 2021). This mechanism aimed to foster intrinsic motivation while avoiding excessive scaffolding that could limit learner agency.

D. Data Collection

Data collection followed a mixed-methods approach to capture both quantitative indicators of reflective performance and qualitative evidence of affective and empathic development. Four primary data sources were employed: (1) digital platform log data, (2) reflective journals, (3) pre–post reflection tests, and (4) semi-structured interviews, enabling triangulation across cognitive, behavioral, and emotional domains. Behavioral observations conducted during design sessions further supplemented these sources by documenting patterns of engagement and affective expression (Dogham et al., 2025). Together, these methods provided a comprehensive view of the reflective learning process.

Table 1. Instruments and Data Collection Techniques

Instrument	Purpose	Data Type	Example Item / Observation Focus	Reference
Reflective Journal (digital)	Capture students' evolving metacognitive awareness	Qualitative	"Describe how feedback influenced your visual decision."	(Alt et al., 2022; Dogham et al., 2025)
Gamified Platform Log	Record engagement metrics and task completion	Quantitative	Time spent, reward achievements, progress level	(Hamari et al., 2023; Hassan et al., 2021)
Pre–Post Reflection Test	Measure idea retention and reflective accuracy	Quantitative	Paired reflection score comparison	(Clark & Mayer, 2024)
Semi-Structured Interview	Explore emotional and creative empathy changes	Qualitative	"How did the gamified feedback affect your creative process?"	(Cotter et al., 2025; Ho et al., 2023)

Quantitative assessments, informed by (Clark & Mayer, 2024), measured reflective accuracy and idea retention through structured pre–post comparisons. Qualitative materials captured shifts in awareness, empathy, and metacognitive insight through narrative reflection and interview responses. Ethical considerations guided all stages of data collection, ensuring voluntary participation, confidentiality, and informed consent (Ho et al., 2023). An overview of the instruments and data collection techniques employed in this study, including their analytical purpose and data type, is presented in Table 1. This structured overview clarifies how each instrument aligns with the reflective, behavioral, and affective dimensions examined in the DBR cycles.

E. Data Analysis

Data analysis employed a triangulated analytical strategy combining qualitative thematic analysis and quantitative statistical procedures. Reflective journals and interview transcripts were analyzed using thematic coding to identify recurring patterns in metacognitive awareness, emotional engagement, and empathic reasoning. This interpretative approach followed established qualitative frameworks proposed by (Cotter et al., 2025; Dogham et al., 2025). Qualitative analysis was supported by NVivo software to ensure systematic coding, transparency, and cross-cycle comparison.

Quantitative data derived from the pre–post reflection tests were analyzed using paired-sample t-tests to examine within-participant changes in reflective accuracy and idea retention. Statistical analysis was conducted using SPSS software, with the level of significance set at $\alpha = 0.05$, consistent with standards in educational and design research. This approach enabled the identification of statistically meaningful changes across DBR cycles. As noted by (Rahnev, 2025)Integrating statistical testing with qualitative interpretation enhances inferential validity by situating numerical trends within the context of learning processes. To enhance analytical transparency, Table 2 summarizes the relationship between each data source, analytical method, and expected analytical output.

Table 2. Summary of Data Analysis Procedures

Data Source	Analytical Method	Purpose	Expected Output
Reflective Journal & Interview Transcripts	Thematic Coding (NVivo)	Identify patterns of metacognition, emotion, and empathy	Thematic Matrix
Platform Log Data	Descriptive Statistics	Examine engagement and progression trends	Frequency & Mean Scores
Pre–Post Test Results	Paired-Sample t-Test	Measure improvement in reflection and retention	Mean Difference (Δ)
Observation Notes	Triangulation Analysis	Validate consistency across data sources	Integrated Insight Map

F. Research Flow

The overall research process is illustrated in Figure 1, which depicts the iterative and cyclical structure of the Gamified Reflective Learning Model. The model consists of three interconnected phases: Design, Implementation, and Reflection, arranged in a circular configuration to represent continuous refinement rather than linear progression. Each DBR cycle also incorporates micro-level reflective loops that enable learners to engage in reflection, redesign, and re-engagement within a single instructional phase. This structure emphasizes learning as an adaptive and evolving process.

This cyclical configuration reflects the core logic of Design-Based Research, wherein learning interventions are progressively reshaped based on evidence derived from practice (An, 2020; Kuhn, 2022). Gamified elements such as progress indicators, feedback checkpoints, and reward cues were embedded within each phase to support engagement without assuming uniform motivational effects across learners. The interconnected arrows in Figure 1 illustrate feed-forward and feedback relationships between cycles. This representation is consistent with (Buchanan, 1992) view of design learning as iterative, contextual, and problem-centered.

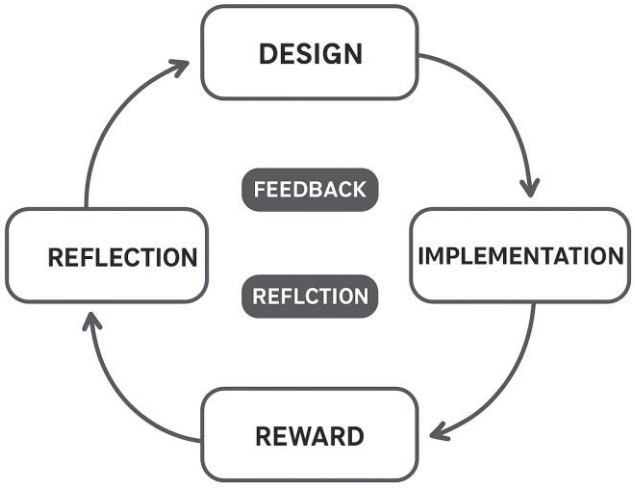

Figure 1. Research Flow of the Gamified Reflective Learning Model

The diagram illustrates an iterative cyclic system that integrates design, implementation, and reflection through feed-forward and feedback loops. The circular motion represents the nonlinear nature of reflective cognition, while embedded gamification elements symbolize motivational, metacognitive, and affective support within the design learning process.

RESULTS

A. Quantitative Results

1. Overview of Quantitative Outcomes

Application of the Gamified Reflective Learning Model resulted in measurable increases in reflective accuracy and idea retention across three DBR cycles. Descriptive statistics indicated a progressive improvement in mean reflection scores, increasing from 68.2 in Cycle 1 to 80.5 in Cycle 3, representing an overall gain of approximately 18%, as summarized in Table 3. Idea retention scores showed a parallel upward trend, suggesting a consistent relationship between reflective accuracy and conceptual understanding. These quantitative patterns warranted inferential statistical testing to determine whether the observed gains were statistically meaningful rather than attributable to chance.

To examine within-participant change, paired-sample t-tests were conducted comparing Cycle 1 and Cycle 3 reflection scores. Results revealed a statistically significant increase in reflective performance ($t(35) = 6.41$, $p < 0.001$), indicating that students demonstrated higher reflective accuracy following repeated exposure to the gamified learning cycles. The magnitude of this effect was moderate to large (Cohen's $d = 0.78$), suggesting practical as well as statistical relevance. These findings indicate that reflective improvement was not incidental but systematically associated with iterative engagement in the gamified reflective model.

Table 3. Retention and Reflection Score Comparison Across DBR Cycles

Cycle	Mean Reflection Accuracy	Idea Retention Score	% Increase
Cycle 1	68.2	71.4	-
Cycle 2	75.6	78.9	+10.5%
Cycle 3	80.5	84.2	+18.0%

2. Progression Trends Across Learning Cycles

The progression trend in Figure 2 shows a steady increase in both reflection accuracy and idea retention across successive DBR cycles. The increasing slope indicates that gains were not uniform but accumulated progressively over time, particularly as learners became more familiar with gamification elements such as badges, progress indicators, and structured feedback mechanisms. This trend aligns with prior research suggesting that repeated exposure to motivational feedback enhances metacognitive calibration and sustained engagement (An, 2020; Hamari et al., 2023). Rather than indicating a ceiling effect, the data suggest continued responsiveness to the intervention, supporting the adaptive logic of Design-Based Research. The pattern is also consistent with findings reported by (Fleming, 2025; Kuhn, 2022), who argue that metacognitive awareness develops incrementally through feedback-driven reflection.

B. Engagement and Interaction Patterns

Behavioral analytics derived from the gamified interface revealed distinct differences in engagement across activity types, as summarized in Table 4. Gamified reflective tasks incorporating progress badges and visual feedback cues demonstrated the highest engagement rates (92%), whereas non-gamified open reflection activities showed comparatively lower initiation and completion rates (74%). Average session duration and feedback frequency further indicated that structured gamified tasks sustained longer and more frequent interactions. These differences suggest that engagement patterns varied systematically as a function of interaction design rather than task content alone.

Inferential comparison of engagement metrics indicated statistically meaningful differences between gamified and non-gamified conditions, supporting the descriptive trends. These results are consistent with (Rivera & Garden, 2021) proposition that timely rewards and visual prompts enhance learner engagement by supporting intrinsic motivational regulation. The observed patterns also align with (Krishnamurthy et al., 2022), who describe how anticipation of feedback sustains attention and reflective depth. Taken together, the engagement data suggest that gamification functioned as a structuring mechanism rather than a superficial motivational overlay.

Table 4. Engagement Rate Across Gamified Reflective Activities

Activity Type	Engagement Rate (%)	Avg. Session Duration (min)	Feedback Frequency
Badge-Based Reflection	92	15.4	4.2
Progress-Tracked Journal	88	14.1	3.7
Open Reflection (Non-gamified)	74	10.8	2.1

1. Interaction Density and Feedback Responsiveness

The interaction density map presented in Figure 2 visualizes patterns of learner interaction across gamified reflection tasks. Areas of higher color density correspond to moments of intensified interaction, typically occurring at points where feedback and reward cues were delivered. This visualization highlights how real-time feedback coincided with peaks in learner activity and sustained task engagement. Aggregated interaction data further indicated that students frequently revisited feedback-rich tasks across multiple sessions, suggesting prolonged reflective involvement rather than one-time task completion. These behavioral patterns support the interpretation that gamified feedback mechanisms contributed to sustained engagement across cycles, consistent with findings reported by (Hassan et al., 2021). Importantly, the figure does not imply causality but illustrates convergence between interaction design and observed engagement behaviors within the learning environment.

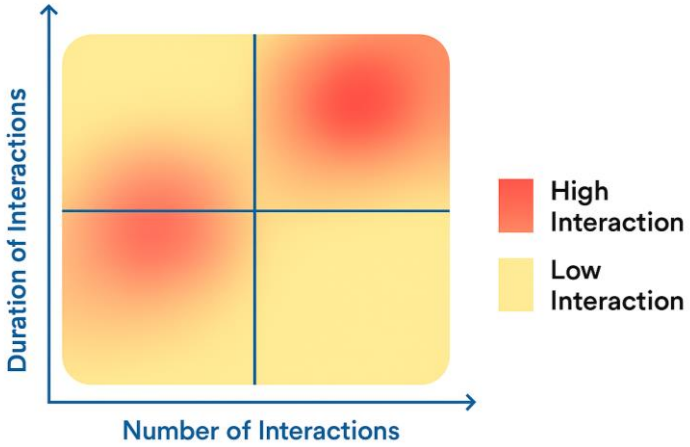

Figure 2. Interaction Density Map of Gamified Reflection Tasks

C. Qualitative Insights from Learner Reflections

1. Thematic Patterns in Reflective Journals and Interviews

Qualitative analysis of reflective journals and semi-structured interviews identified three dominant thematic categories: emotional resonance, sensory awareness, and social connectedness, as summarized in Table 5. These themes emerged consistently across participants and DBR cycles, indicating stable patterns in learners' reflective experiences. Rather than treating reflection as a purely evaluative task, students increasingly described it as an experiential and interpretive process. This shift was evident in narrative accounts that emphasized emotional meaning, perceptual sensitivity, and audience awareness.

Participants frequently articulated how gamified reflection transformed their perception of design reflection from a grading requirement into a more expressive and personally meaningful activity. These findings align with prior work on empathy development and reflective learning in design contexts (Cotter et al., 2025; Dogham et al., 2025). The qualitative evidence suggests that the interactive architecture of the gamified platform supported deeper engagement with affective and imaginative dimensions of design practice. Importantly, these insights complement rather than duplicate the quantitative findings.

Table 5. Empathy Mapping Themes Extracted from Reflective Discussions

Theme	Description	Frequency (%)	Representative Quote
Emotional Resonance	Recognition of emotion behind visual choice	38	"Colors felt like my emotion turned visible."
Sensory Awareness	Conscious attention to visual rhythm and form	33	"I realized balance can sound like silence."
Social Connectedness	Understanding the viewer's perspective	29	"Design feels like a shared conversation."

2. Thematic Convergence of Reflective Awareness

The thematic relationships among emotional resonance, sensory awareness, and social connectedness are visualized in Figure 3**.** The intersecting regions of the diagram illustrate that reflective awareness was not compartmentalized but developed through interconnected affective and cognitive dimensions. Learners described heightened sensitivity to the relationship between emotional intuition and visual decision-making, reinforcing the integrative nature of reflective cognition. These findings are consistent with metacognitive research suggesting that regular self-monitoring strengthens self-awareness and creative problem-solving (Fleming, 2025; Fleur et al., 2021). Rather than positioning gamification as an extrinsic motivator, the qualitative results indicate its role in structuring reflective experience. In this regard, gamified reflection supported the parallel development of empathy, awareness, and design sensitivity without reducing reflection to a mechanistic process.

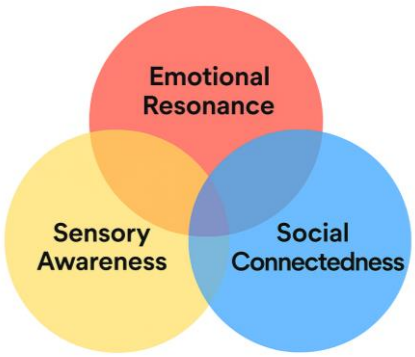

Figure 3. Thematic Convergence of Reflective Awareness

DISCUSSION

A. Interpretation of Findings

The findings suggest that gamified reflective learning can reframe reflection from a predominantly passive exercise into a more active, participatory process in the context of design education. Rather than claiming universal effectiveness, this outcome should be understood as contextual and exploratory, emerging from a Design-Based Research (DBR) implementation situated in a specific instructional setting. Within this framework, reflection functioned not only as an evaluative activity but also as a design practice that integrates cognitive monitoring and affective engagement. These results provide preliminary evidence that structured gamified elements may support reflective depth when carefully aligned with pedagogical goals.

Across several iterative learning cycles, students demonstrated progressive refinement in reflective precision and conceptual understanding of design processes, as illustrated in Figure 2. This pattern indicates a trend of improvement rather than a definitive optimization, consistent with the iterative logic of DBR. The observed changes can be interpreted as the outcome of

feedback mechanisms, progress indicators, and incentives that supported learners' self-regulation and alignment between visual artifacts and conceptual goals (Fleming, 2025; Kuhn, 2022). Importantly, these mechanisms operated within a guided instructional ecology, rather than as standalone motivational tools.

In addition, the findings align with perspectives that view reflection as encompassing both cognitive and affective dimensions of learning. The results indicate that emotional engagement played a mediating role in shaping students' reflective quality, contributing to a more integrated creative identity through the acknowledgment and articulation of emotions (Caroline Wibowo & Raharjo, 2023; Dogham et al., 2025). By positioning reflection as a more engaging, embodied activity, students appeared to develop greater confidence in navigating the iterative, non-linear nature of design thinking. This interpretation remains cautious and situated, emphasizing experiential learning rather than claiming generalized transformation.

B. Comparison with Previous Studies

The results of this study are consistent with prior research highlighting the role of gamification in fostering engagement within learning environments. In line with (Khaldi et al., 2023)The findings indicate that timely feedback and visual rewards can help sustain learner involvement across repeated activities. However, rather than emphasizing behavioral compliance, as is often the case in conventional e-learning gamification (Saleem et al., 2022), this study suggests that gamified reflection may support deeper cognitive and affective engagement. This distinction is particularly relevant for design education, where reflective autonomy and empathetic awareness are central learning objectives.

Furthermore, the application of reflective gameplay extends the theoretical framework proposed by (Rivera & Garden, 2021), which conceptualizes gamification as an adaptive narrative mechanism for meaning-making. In this study, gamification functioned as a reflective scaffold, enabling students to articulate experiences and values across iterative cycles rather than responding superficially to visual stimuli. The social and emotional learning outcomes observed here also resonate with (Cotter et al., 2025), who identified empathy as a key outcome of interactive digital visual art experiences. A key contribution of the present study, however, lies in situating empathy within sustained reflective cycles rather than as an immediate affective response to artifacts.

From a design cognition perspective, these findings underscore the role of reflection in integrating metacognitive monitoring with affective awareness. The DBR approach allowed for an iterative alignment between theory and practice, combining insights from metacognition

research (Fleur et al., 2021; Rahnev, 2025) with the emotional and social competencies essential to creative work. The mixed-method design enabled an integrative interpretation of behavioral engagement data (Table 4, Figure 3) alongside emergent emotional reflection themes (Table 5, Figure 4). This balance supports a nuanced understanding of learning transformation, rather than privileging quantitative outcomes alone.

C. Assessment and Constraints

Despite these contributions, the study has several limitations that should be acknowledged. Participant sampling was limited to undergraduate design students at a single institution, which constrains transferability and precludes broad generalization. In addition, the long-term sustainability of reflective motivation fostered through structured gamified cycles remains an open empirical question. Future research should adopt longitudinal and cross-contextual designs to examine how gamified reflection translates across disciplinary, cultural, and institutional settings.

Within these constraints, the study provides context-sensitive insights into how gameful design can support reflective practice in situ. Rather than claiming definitive effectiveness, the findings indicate the potential of gamification to function as a pedagogical mediator for metacognitive development, empathetic understanding, and reflective design cognition (An, 2020; Hamari et al., 2023). These outcomes should be interpreted as exploratory contributions, grounded in DBR methodology and intended to inform iterative pedagogical refinement. As such, the study contributes to ongoing theoretical and practical discussions on reflective practice in design education without overextending its claims.

CONCLUSION

This study suggests that gamified reflective learning can support students' understanding of design processes and their ability to relate visual decisions to underlying conceptual intentions within a specific educational context. Rather than claiming definitive proof or universal effectiveness, the findings provide preliminary and context-bound evidence that feedback loops, reward systems, and progress indicators may enhance reflective engagement and metacognitive awareness when embedded in structured learning cycles. Within the Design-Based Research (DBR) framework, reflection was repositioned as an active component of the design process, integrating cognitive monitoring and affective involvement. The contribution of this study is therefore interpretive and exploratory, emphasizing pedagogical refinement rather than generalizable causal claims.

From a contribution perspective, this research offers three interrelated advances. Theoretically, it extends theories of reflective practice and metacognition by illustrating how affective engagement and empathy can be cultivated through reflective play in design education. Pedagogically, it demonstrates a situated instructional model in which reflection operates as an emotionally engaging design activity rather than a purely evaluative task. Methodologically, the study illustrates the value of DBR in iteratively aligning theory, design intervention, and classroom practice, while also acknowledging its limitations, including a restricted sample size, a single institutional context, and a limited intervention duration. Future research should therefore examine longitudinal effects and cross-cultural applications to assess how reflective gamification may function across diverse disciplinary and educational settings without assuming universal applicability.

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