

# Exploring Reflective Learning in Digital Game-Based Learning: A User Research Study

Anjuman Shaheen and Panagiotis Fotaris

University of Brighton, UK

[A.Shaheen@brighton.ac.uk](mailto:A.Shaheen@brighton.ac.uk)

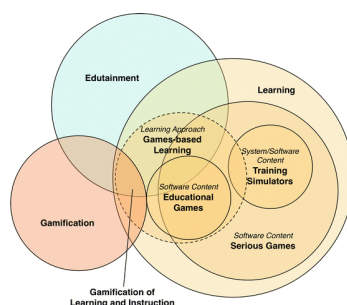
[P.Fotaris@brighton.ac.uk](mailto:P.Fotaris@brighton.ac.uk)

**Abstract:** Reflective learning has gained popularity as an effective form of education that involves students reflecting on their past experiences to enhance their skills and learning. In recent years, it has been observed that games offer experiential learning and are reflective in nature, making them the ideal medium to integrate reflective learning. With digital games being popular among people of all ages, particularly young adults and children, this study explores the advantages of explicitly incorporating reflective learning into digital game-based learning (GBL) by investigating young adults' perceptions of reflective game design (RGD). Research suggests that digital games implicitly promote reflective learning by encouraging critical thinking, self-awareness, problem-solving skills, and motivation. Additionally, reflective learning provides immediate feedback to students, promoting self-directed learning. Allowing students to reflect on their gaming experiences can make digital games more immersive, leading to deeper learning. The study was conducted in two phases. In the first phase, a survey was administered to 101 young adults between the ages of 18 and 24. The survey aimed to get participants' perceptions and acceptance of games exhibiting reflective features such as heads-up displays, screen maps, message prompts, and performance comparison charts. The results showed that 86.5% of participants accepted the idea of reflective game design, indicating a high level of interest in this approach to learning. In the second phase, fifteen in-depth interviews were conducted to explore further participants' perceptions and acceptance of reflection in games. The thematic analysis of the interviews revealed common trends in using reflective game practices to design a new GBL approach. Participants noted that reflective game design can foster deeper learning, promote problem-solving skills, and enhance learning motivation. This study contributes to developing principles and guidelines for RGD that can assist researchers, educators, and game designers in creating effective educational games. By explicitly incorporating reflective learning into digital GBL, educational games can become more engaging, immersive, and effective in promoting critical thinking, STEM literacy, self-awareness, problem-solving skills, and motivation among students.

**Keywords:** Reflective learning, Game design, Reflective game design, Learning theories

## 1. Introduction

In the past decade, digital games have gained recognition as an effective medium for educational purposes and training (Gee, 2004). A survey conducted by the Games and Learning Publishing Council revealed that approximately 55% of 700 teachers incorporated game-based activities into their weekly lesson plans (Takeuchi and Vaala, 2014). The concepts of serious games, Game-Based Learning (GBL), e-learning, and gamification have garnered significant attention in both academic and edutainment domains over the past decade (Martens and Müller, 2017). These concepts often overlap and share common elements, making it challenging to draw a clear distinction between games and artefacts with game elements. Figure 1 depicts the relationship between game-based learning, gamification, and edutainment, highlighting their interconnected nature.



**Figure 1: GBL, gamification and edutainment (after (Martens and Müller, 2017))**

GBL is an active instructional approach that integrates game characteristics, gamification, learning goals, and pedagogical methods into educational activities, as depicted in Figure 1. According to Prensky (2003), digital GBL can enhance learning experiences by making them engaging and motivating for students. The element of "Play" in GBL is crucial, as it enables learners to connect and interpret their physical and social environments, fostering meaningful learning interactions (Gee, 2004). GBL leverages gaming technologies and techniques to

create immersive and interactive virtual learning environments that promote situated experiential learning (Fotaris and Mastoras, 2019).

Since the last decade, various GBL frameworks have been developed, and learning theories have been incorporated to understand best how games can engage learners in the material. (Kiili, 2005)'s *“Experiential Gaming Model”* focuses on combining experiential learning theory (Kolb, 1984), flow theory and game design to create a new GBL model. It emphasizes that the use of immediate feedback, clear goals and challenges matched to the player's skill level allow for meaningful and engaging learning by experiencing flow. In addition, the Adaptive Digital GBL framework (Tan et al., 2007) has a preliminary focus on the pedagogical elements, psychological needs, cognitive development, and learning behaviours to help understand the learners' learning abilities so that the game can be tailored towards the target group.

Moreover, learning theorists have accepted reflective practice as a well-established learning method since the start of this century (Reynolds, 2011). Reflective learning is a form of education in which student reflects upon their experiences to learn and improve their skills. In this era, where digital games are already accepted as an excellent medium of education, learning theories are being integrated into game-based learning (GBL).

### 1.1 Learning Theories in Game Design

In game design, learning theories like behaviourism, constructivism, and cognitive theory serve as frameworks for enhancing learning experiences. By integrating these theories, educators and game developers have the opportunity to create educational games that are both immersive and effective in facilitating learning (Dondlinger, 2007). In learning theories, reflective learning is now integral to effective learning. In literature, different models such as Gibb's reflective cycle (Gibbs and Unit, 1988), and the experiential learning model (Kolb, 1984) have incorporated reflection into the learning process. Out of them, the experiential learning model (Kolb, 1984) implementation is closely aligned with the game experience (Shaheen et al., 2022). In addition, game features also provide in-action and on-action reflection. To understand the concepts deeply, the following section explains the experiential learning model (Kolb, 1984) and the in-action-on-action reflection (Schon, 1983).

### 1.2 Reflective Learning in Game

The researchers, educators and instructional designers are working on incorporating reflective practices into a learning environment (Fleck and Fitzpatrick, 2010, Villareale et al., 2020). Sengers et al. (2005) stressed the importance of reflective practices in game design and came up with the term *“Reflective Game Design”* for the first time. Later, Khaled (2018) published her work explaining the game elements that are suitable to support reflective learning in games and quoted, *“Games are reflection machines”*.

While games inherently possess reflective qualities, only a limited number of existing GBL frameworks incorporate active reflection methods and practices to engage players in the learning process. Among the reviewed literature, Kiili (2005) briefly mentioned the inclusion of reflective feedback in their Experiential Gaming Model; however, their primary focus was on the development of GBL using flow theory. In contrast, the Reflective Game Design (RGD) framework (Shaheen et al., 2022) represents a more recent and iterative model that emphasizes the enhancement of learning through reflective observation and authentic feedback. Reflective feedback holds a central position within this framework, as depicted in Figure 2, enabling the integration of reflective learning elements throughout each stage using experiential learning methods (Kolb, 1984). In the RGD framework, learning in each cycle will be measured by the formative assessment, and consequently, learning results will be used on the next cycle.

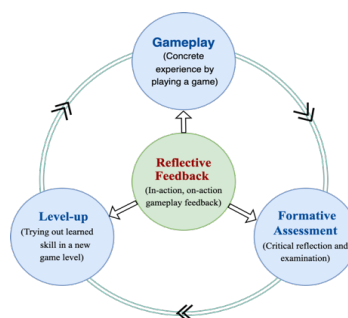


Figure 2: RGD designed Framework (Shaheen et al., 2022)

Moreover, a systematic review of using reflective design features in game-based learning (Shaheen et al., 2021) concluded that reflective design features in GBL improve the learning process, i.e. 1) process displays and prompts improve understanding, 2) social discourse enhances user experience among players with active engagement, 3) process models validate users' learning, yielding learning confidence, and 4) other reflective features such as reflective modes lead to improve critical thinking, problem-solving and retention rate. There is enough evidence of positive outcomes of incorporating reflective practices into GBL. In GBL, games can provide concrete experience with learning reflection in action and reflection on action in the form of Heads up Displays (HUDs), progress bars, visual breadcrumbs, and leader-boards. It is intriguing to research incorporating reflective learning techniques into GBL and their impact on learning.

### **1.3 Study Objectives**

This ongoing research aims to involve the target audience in a design process, and this preliminary study primarily focused on the following objective:

- Investigate the promotion of reflective learning through digital games.
- Assess the acceptance and interest in reflective game design.
- Explore participants' perceptions of reflection in games.
- Identify the benefits of reflective game design.
- Contribute to the development of principles and guidelines.

Hence, the objective of this study is to integrate reflective learning into digital Game-Based Learning (GBL) while providing evidence of its increasing advantages. The subsequent sections of this paper are organized as follows: Section 2 provides a comprehensive discussion of the methodology employed and the details of data collection, Section 3 presents the findings from the User Research, and Section 4 concludes the paper, highlighting avenues for future research.

## **2. Methodology**

The study employs a combination of quantitative and qualitative methodologies, with careful alignment of strategies to the research questions and overall objectives of the investigation. Therefore, the *pragmatic paradigm* (Mackenzie and Knipe, 2006) is a suitable research paradigm for conducting research design. This study aligns with the "*Human Centred Design approach*" (ISO 9241-210:2019, 2019) which underscores the critical involvement of users in every stage of the iterative design process, including design development, evaluation, and refinement. Accordingly, the following methods were employed to facilitate the research process:

- A user survey to know the target audience; the structure of the user survey consisted of 12 sets of questionnaires about general gaming habits to collect quantitative data of
  - Target audience gaming habits.
  - Target audience knowledge of serious games.
  - Target audience understanding of reflection in games.
- Semi-structured interviews were designed to collect qualitative nature of data. The following are the learning goals of the user interview:
  - To understand participants' knowledge regarding games and "*serious games*".
  - To know participants' understanding of reflection and whether they can relate reflection with games.

### **2.1 Recruitment**

The study recruited participants from the target audience of young adults aged 18-24, specifically targeting undergraduate students at the University of Brighton, social forums, and online gaming communities. Recruitment efforts included email invitations to students and the distribution of advertisement flyers within the university and on social media platforms. Ethical considerations were diligently addressed, and ethical approval was sought from the Brighton Research Ethics Application Manager (BREAM) to ensure the appropriate handling of human subjects in the study.

For preliminary user research, this study chose participants with experience playing games to avoid diversity. The designed recruitment survey has a screening question leading to categorising participants based on whether they like to play games or not.

## **2.2 Data Collection**

Data collection in this research adhered to strict anonymization procedures. During interviews and group sessions, no personal or confidential inquiries were made. Participants were provided with a consent form containing an information sheet, which they were required to read and sign. They were explicitly informed about the voluntary nature of their participation. The data collection process consisted of two phases:

### *2.2.1 A user survey*

As the initial effort to engage the audience in reflective learning through games, the study adopted a sequential approach, commencing with an exploration of general gaming habits and gradually introducing the concept of reflective learning to the target audience. The purpose of Survey (Shaheen, 2022) was to keep this survey simple and friendly to get users' true interests. The survey consisted of three components, 1) general gaming habits, such as what type of games they usually play; 2) Participants' knowledge of serious games; 3) How they perceive the idea of reflection through games.

Each question has one open-ended optional response to collect the free thoughts of participants. It was observed that the target audience might not understand the concepts; hence, straightforward explanations were provided for their clarity. The survey was built and distributed over the JIS online survey provided by the University of Brighton.

### *2.2.2 A semi-structured interview*

A comprehensive data collection approach involving semi-structured interviews to obtain detailed and in-depth insights. The interviews were carefully conducted, with a duration ranging between 30 to 40 minutes. The interview process was based on a friendly discussion atmosphere, aiming to establish a comfortable environment that encouraged participants to openly share their perspectives and experiences. The survey findings set the groundwork for the interviews and provided important pointers to discuss with participants in a one-to-one interview. Therefore, the interview script and questions were modified to fit identified pointers.

The semi-structured interview was divided into three categories i.e., 1) Warm-up questions with participants' gaming habits and likeness; 2) Serious games and GBL; and 3) Reflection through games.

The email invitation with the consent form was sent to the 39 participants who signed up for the one-to-one interview, and 15 participants appeared for the interview. Interviews were led to triangulate a preliminary interpretation of the user survey's observations and examine the participants' perception of learning through reflection by games from June 2022 to August 2022. The interviews were conducted online over MS Team, Zoom, and Google Meet according to the participant's preference to overcome geographical and temporal limitations. All interview discussions were transcribed for further analysis using the qualitative analysis tool NVivo. Initially, transcriptions were coded by structure, allowing interviews to be conducted until "*category saturation*" was achieved (Strauss and Corbin, 1990). Hence, data collection stopped when no new codes were developed during the analysis (Baker and Edwards, 2017).

The researcher initiated the semi-structured interview with the research introduction and warm-up questions such as, "What type of games do you like to play?" with a possible follow-up question, "How long do you usually play games every week?" to make participants comfortable. Each question was designed to have a few follow-up questions to carry out a natural discussion. It was ensured that user participation would be friendly to know their genuine opinions and maintain reflexivity.

## **3. User Research Findings**

### **3.1 Gaming Habit Survey**

During the initial distribution of the survey, a total of 100 responses were obtained. Out of these, 92 responses successfully passed the first screening question, which inquired about participants' engagement in gaming. These 92 responses were deemed suitable for further analysis. The quantitative analysis of the Gaming Habit Survey can be divided into three distinct parts for systematic examination and interpretation.

- Regarding the general gaming habits of the target audience, it was observed that participants typically engage in gaming activities on both PC and mobile platforms, dedicating approximately 1 to 5 hours per week to gaming. The most frequently played game genres were identified as First-Person Shooting (FPS) games, including popular titles such as Call of Duty, and Counterstrike, as well as casual games like Candy Crush and various life/farming/building games (e.g., Stardew Valley.).

Findings from the survey indicated that 44.9% of research participants reported a preference for playing games alone, while 28.1% preferred playing with friends, and 27% expressed a desire to play either with friends or by themselves. Interestingly, a significant portion of participants (55.1%) expressed their interest in gaming due to the mental challenges it presents (as depicted in Figure 3), with realism/graphics ranking as the second most influential factor driving participants' attention.

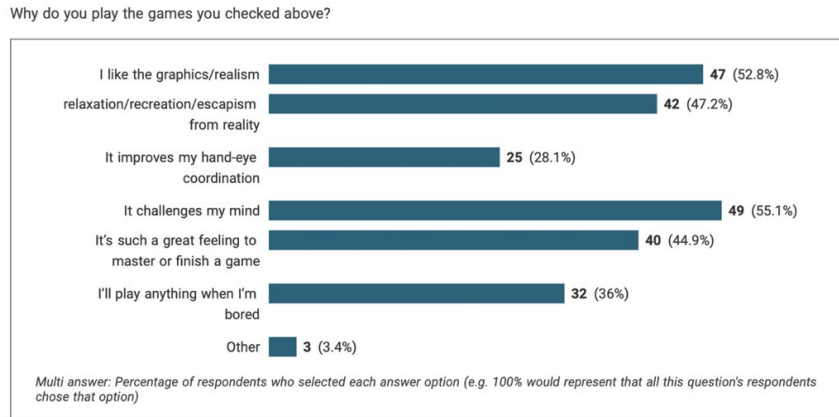


Figure 3: Histogram depicting the element of game engagement in young adults

- Despite the extensive research conducted in the field of serious games and game-based learning (GBL), the survey findings indicate that only a modest proportion of participants, namely 27%, possess knowledge regarding GBL and serious games (refer to Figure 4). Notably, respondents provided additional categories of games, including "Cyber Security Escape Room" and one participant highlighted the benefits of serious games, specifically mentioning the enhancement of reflexes, the stimulation of cognitive processes leading to novel ideation, and the acquisition of problem-solving skills.

Did you ever hear of "serious games" or "Game-based learning"?

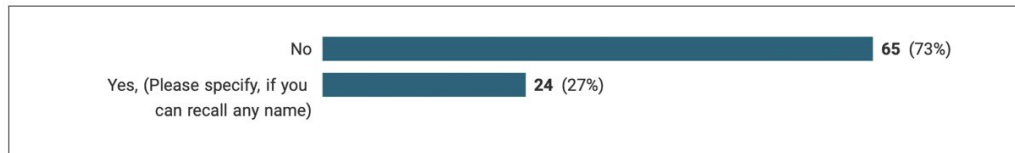


Figure 4: Histogram depicting the knowledge of GBL and serious games in young adults

- The third component of this survey focused on examining the target audience's perception and acceptance of the concept of reflection through games, reflective game features, and reflective learning. Following the clarification of these terms, participants were asked whether they deemed games suitable for facilitating reflective learning. The survey garnered a substantial positive response of 86.5% (as depicted in Figure 5). Subsequently, participants were queried about their observations concerning game elements that exemplify reflection. According to survey responses (shown in Figure 6), Heads-Up Displays (HUDs), such as on-screen scores, maps displaying player location, and progress bars, were highly regarded as practical game elements supporting reflection and reflective learning. The social collaboration received a significant response rate of 60.7%, with multiplayer games being the most prevalent platform for social discourse. Additionally, most participants recognized the significance of a "Process Model" that enables the comparison of players' strategies as a valuable contributor to reflective learning. The remaining options also yielded noteworthy responses, contributing to a comprehensive understanding of the participants' viewpoints. The other option gained an insightful response:

*"I think the best practice which compels player for reflective behaviour is giving him loss/punishment over his mistakes. Just the way it is in real life. Humans learn from their mistakes. Mistakes that gave them a loss".*

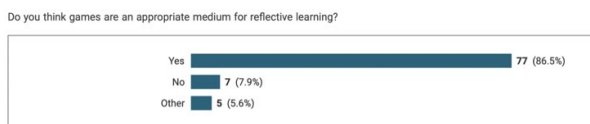


Figure 5: Histogram depicting the acceptance rate of games as an appropriate medium of reflective learning

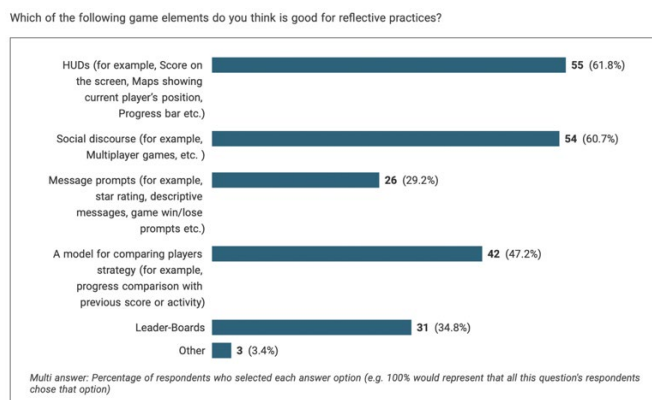


Figure 6: Histogram of the acceptance rate of games as an appropriate medium of reflective learning

### 3.2 User Interviews Analysis

The qualitative analysis of semi-structured transcription can be categorised into two parts:

#### 3.2.1 Coded by structure

The interview transcriptions were initially subjected to structure coding, following the methodology proposed by Braun and Clarke Braun and Clarke (2006), using NVivo software. A thorough reading of the transcriptions facilitated the identification of essential sections of text that captured the qualitative richness of the phenomenon under investigation, aligning them with relevant themes or issues in the data and research questions (King, 2004). Memos were diligently recorded to highlight intriguing aspects of the data and emerging impressions that had the potential to form the basis of thematic patterns across the dataset. Subsequently, a word frequency analysis was conducted on the extracted codes to obtain statistical insights into popular games, game genres, current trends, and participants' common interests. From this analysis, it emerged that most participants expressed a preference for playing story-enriched, mentally challenging, strategic, adventure, and puzzle games (as illustrated in Figure 7).



Figure 7: Word Frequency Cloud for Game Type

#### 3.2.2 Reflexive Thematic Analysis:

Following the structured coding of the interview transcriptions, a reflexive thematic analysis (Braun and Clarke, 2020) was performed to identify recurring themes and participants' interests that could inform the decision-making process for preliminary design iterations. The resulting breakdown of the identified themes is presented comprehensively in Table 1.

Table 1: Overview of themes from the analysis

Transcending Theme	Major Themes	Sub Themes
The concept of reflection through games-based learning (GBL)	Popularity of games.	Games provide competitiveness. Games provide mind challenges. Games provide a rich story.
	Game as a medium of learning.	Games can help in learning acceptance. Games can help in learning patience. Games can help in learning awareness and mindfulness. Games can help in learning skills such as strategy building and planning.
	Game features supporting reflection.	Reflection in games. Reflective feedbacks such as process displays, prompt messages, and social discourse.

- Transcending Theme: Analysis suggests that participants' responses were generally in favour of the concept in the discussion about comparing the process of reflection with games. A few participants' responses are quoted below:

*"Games make me rethink certain situations. Whenever I leave a certain level unfinished, all the scenarios, keep circling in my mind, and I think about different actions if I would take to pass the level."*

*"Games help the participant to reflect in real-time to reflect their experience. Reflection in games also has given the freedom to fail, retry and retry."*

*"Keeping updated, when learning a new vocabulary, when a word stuck in mind and when it eventually pops up in a game or conversation using the ability to revisit this and either uses previous learning or refresh memory."*

*"On the spot will think of the action, do something well, get killed, tries to reflect on where he went wrong. While waiting to respawn, plan the next actions. (In the death timer)."*

*"It's actually the message the game rules are giving me that makes me rethink or evaluate my approaches to the game."*

*"I think it's learning through the experience you gained by failing again and again or by experimenting with different approaches to the problem."*

*The above quotes imply that the participants accepted the idea of reflection through games, and they quickly understood and could relate the reflective learning process with games.*

- Major Themes: Three major themes were identified, and each of these themes comprises several sub-themes: The theme analysis shows that most participants like those games that provide competitiveness, mental challenges, and a rich story. One of the participants said during the interview, *"Most of the time, competitiveness in games derives me from playing"*. Another participant said that he would like *"any game with strong responsive mechanics and challenging difficulty"*. A few participants talked about the game story as one of the reasons they would remain engaged in the game, *"I love story-enriched games"*. The third most repetitive reason given by the participants was *"game challenges their mind"*. One participant said: *"Puzzle games, which challenge my mind. I play till it challenges my mind, and then I switch the game if it's too easy"*, and another mentioned, *"Any game with strong responsive mechanics and challenging difficulty"*.

*"Game as a medium of learning"* is identified as a second major theme. The gaming habit survey revealed that most participants are unaware of serious games or GBL; therefore, during the interview, they were asked whether they have learned any learning from games. They listed that games could help in learning acceptance, patience, awareness and mindfulness and other skills such as strategy building and planning. One participant spoke about their experience of games regarding mindfulness and acceptance *"(game)Life is strange;*

*accepting that some things you can't (or can) control. Live in the moment and try not to think too much ahead.*" another participant stated, *"Helped learn patience and planning"*. In addition, *"rage quitting"* was another skill learned from playing games with one of the participants.

The third most crucial theme was *"Game features supporting reflection"*, Participants agreed that they found games' features reflective in nature. The following two participants' statements support this theme, i.e., *"The games I play are already made on this reflective cycle"* and *"I agree, I can relate a game experience with this reflective cycle"*. A few participants talked about the importance of game features such as HUDs and prompt messages; they said, *"It's actually the message the game rules are giving me is what makes me rethink or evaluate my approaches to the game"* a few participants revealed that *"I agree that Audio/Visual feedbacks such as HUDs, display prompts play a vital role in learning"*, *"Leader board - competitive nature motivates you to improve by repeating, Death recap (dependant on the game. e.g., in strategic, RPG based games)"*, and *"Helped me to gain an outside perspective and experience. Leader boards, helps understand progress"*. Despite reflective feedback importance, one participant pointed out, *"HUDs and GUDs can sometimes be too big and overwhelming on the screen (in mobile games). Only use necessary information. Requires simplicity."* and *"Sometimes HUDs is a distraction when you have lots to do. Otherwise, they are very helpful"*.

#### **4. Discussion**

The in-depth analysis of the user research data has yielded intriguing findings, underscoring the significant potential of games as a means of facilitating reflective learning. The outcomes highlight the capacity of games to offer a transformative learning experience characterized by critical thinking, self-awareness, problem-solving skills, and motivation. The data analysis showcases the effectiveness of games in promoting reflective learning, demonstrating their ability to engage learners and encourage deeper levels of comprehension and knowledge acquisition. The most important findings are:

- Among the participants surveyed, the genre of FPS emerged as the most popular category of games. FPS games encompass a wide range of elements, including strategic planning, puzzle-solving, multiplayer interactions, and more. It was of particular interest to explore the factors that contribute to the popularity of this genre. To delve deeper into this aspect, the interview questions were modified to gather detailed insights. The subsequent analysis of the interview data shed light on the key elements that make FPS games appealing, namely engaging puzzle activities, immersive and captivating narratives, strategic game mechanics, and mentally stimulating challenges. These findings provide valuable insights into the preferences and interests of the participants, informing the design and development of future games within the FPS genre. These findings will be incorporated into ongoing research aimed at co-designing a game that integrates reflective learning principles.
- Although 73% of participants were unaware of "Serious games" or "Game-based learning," they reported that digital games facilitated the development of various skills, including acceptance, patience, hand-eye coordination, freedom to explore, mindfulness, and strategic thinking.
- Interestingly, the participants demonstrated agreement regarding the concept of "reflective learning through games," as evidenced in Figure 10. This shared perspective served as a key motivator for the integration of a reflective cycle into the interview script, enabling in-depth discussions on the topic. Notably, a subset of participants expressed a preference for simplistic heads-up displays (HUDs) to facilitate game progress reflection. These individuals perceived complex and cumbersome HUDs as potentially distracting and overwhelming, emphasizing the importance of user-friendly design considerations in promoting effective reflective learning experiences within games.

Based on the user research conducted in this study, it becomes evident that the target audience possesses a comprehensive understanding of reflective learning through games. Despite limited familiarity with terms such as "serious games" or "game-based learning," participants exhibited a highly positive response towards the concept of reflective learning within digital games. Their interviews further revealed valuable insights on improving reflection through game elements, particularly heads-up displays (HUDs). Consequently, this research offers compelling evidence of participants' acceptance of digital games as a superior medium for facilitating reflection. Participants emphasized that games enable them to engage in concrete experiences, reconsider situations, reflect upon them, and make subsequent attempts, a fundamental aspect of the reflective learning process. These findings shed light on the transformative potential of games as educational tools and lay the foundation for the development of innovative and impactful reflective game-based learning approaches.



## 5. Conclusion and Future Work

The present study investigated the perception of young adults regarding "reflective learning" within a digital game context. Data was collected through a user survey and semi-structured interviews, employing qualitative and quantitative analyses to extract insights into the interests of the target audience. The results consistently indicated that games, even if not explicitly designed as serious games, can effectively facilitate reflective learning. This involves providing users with concrete experiences, encouraging a rethinking of situations, facilitating reflection on experiences, and offering a platform for improvement based on past experiences. These findings will inform the design decisions for creating a game aimed at enhancing self-awareness.

In the future, these designs will serve as the foundation for co-design sessions with participants to develop a game-based learning (GBL) experience supporting "*Reflective Game Design*". The final reflective game design will undergo evaluation, with the results used to establish guidelines and principles for reflective game design.

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