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Changing Beliefs: The Use of a Playful Approach to Foster a Growth Mindset

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Abstract

The introduction of new technologies has reshaped both workplaces and learning environments, requiring the development of transversal competences such as adaptability, reflection, and perseverance. Following the COVID-19 pandemic, playful approaches have been increasingly adopted in educational settings to enhance engagement, attention, and motivation, as well as to foster awareness of specific topics. In collaboration with the Cologne GameLab, a game prototype entitled *Intergalactic Growth* was developed to improve understanding of the growth mindset and to promote perseverance, self-awareness, and critical behavior in the use of ChatGPT. This study has two main objectives: to address the growth mindset from an educational and neuroscientific perspective, and to collect qualitative insights on the prototype's usability and pedagogical potential. Data were gathered through a focus group and analyzed using reflexive thematic analysis (RTA) with NVivo 14. The findings suggest that *Intergalactic Growth* effectively stimulates emotional engagement and reflection but requires refinement to enhance its pedagogical impact, particularly concerning feedback authenticity and the integration of ChatGPT.

Keywords: growth mindset; playful learning; education; neuroscience; gamification; reflection

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1. Introduction

The rapid diffusion of new technologies has profoundly transformed both teaching and working practices, reshaping learning processes and the skills the labor market demands. In this context, individuals are increasingly required to develop transversal competences that allow them to adapt, reflect, and respond resiliently to change.

Following the COVID-19 pandemic, the European Commission's *LifeComp* framework (2020) emphasized the importance of *learning to learn* as a key competence for lifelong learning, highlighting the need for people to take an active role in society. Within this framework, the concept of the growth mindset (Dweck, 2000, 2017)—often referred to as the *dynamic mindset*—represents a crucial dimension of *learning to learn*, as it values the processes of personal development and transformation.

According to Dweck (2017), a growth mindset entails the belief that intelligence and abilities are not fixed traits but can be cultivated through effort, persistence, and deliberate practice. This orientation resonates with theories of intrinsic motivation (Deci & Ryan, 2000), temporal agency (Emirbayer & Mische, 1998), and reflective practice (Schön, 1983), forming a pedagogical foundation that aligns with transformative learning (Mezirow, 2003).

From this perspective, education plays a central role in fostering openness, flexibility, and the capacity for continuous self-renewal.

The increasing integration of technologies in learning and work environments has produced both opportunities and challenges. While digital tools have facilitated access to information and collaboration, they have also contributed to reduced motivation and attention in some contexts. To counter these effects, playful approaches have gained traction as effective pedagogical strategies. Gamification—the application of game elements in non-game contexts (Deterding et al., 2011)—has been used across educational and corporate settings to enhance motivation and engagement (Dicheva et al., 2015; Alioto & Persico, 2024). However, as noted by Bogost (2015), many gamified systems fail to achieve meaningful learning because they prioritize superficial incentives, such as points and badges, over reflective or process-based engagement.

In response to these limitations, and in collaboration with the GameLab of TH Köln, the authors designed *Intergalactic Growth*, a prototype explicitly aimed at introducing and reinforcing the growth mindset through reflection, awareness, and perseverance. The game was conceived primarily for adult workers aged 50–60, a population often characterized by resistance to change and difficulty in envisioning alternative professional identities. Nonetheless, this preliminary study tested the prototype with undergraduate students to explore its emotional and reflective potential prior to the adult implementation phase.

We purposely adopted a small, self-contained game-based learning prototype instead of a thin layer of gamification because our pedagogical goal was reflection, perseverance, and mindset reframing, which require narrative coherence, meaningful choices, and emotionally salient feedback. As argued in the gamification literature, superficial "pointsification" often boosts performance without fostering understanding or transfer. A game allows us to weave story, challenge, and reflective pauses into a single experience, thereby operationalizing growth-mindset mechanisms (e.g., reframing failure, metacognition) beyond mere reward structures (Antonaci et al., 2019). In this sense, the prototype sits within the playful learning spectrum: it borrows selected gamification mechanics, but it is intentionally designed as a game-based environment to enable deeper reflective engagement and potential mindset change.

This article thus pursues both theoretical and empirical objectives:

1. To discuss the pedagogical and neuroscientific underpinnings of the growth mindset;
2. To examine the empirical findings emerging from qualitative reflexive thematic analysis (RTA) of gameplay experiences with *Intergalactic Growth*.

Accordingly, this paper is structured as follows:

- Section 2 explores the growth mindset from educational and neuroscientific perspectives;
- Section 3 discusses playful learning and neurocognitive implications, presenting the prototype design;
- Section 4 details the qualitative methodology and analysis through NVivo 14;
- Section 5 presents the results and themes;
- Section 6 discusses implications for design and pedagogy;
- Section 7 concludes with recommendations and limitations.

2. Growth Mindset: Towards Educational Sciences and Neuroscience

2.1. Growth Mindset from an Educational Perspective

Within the constructivist paradigm, knowledge cannot be regarded as an objective or neutral "photograph" of reality; rather, it emerges through the continuous interplay between perception, interpretation, and reconstruction of experience (Siegel, 2011). As Maturana and Varela (1980) explain, cognition is not the passive reception of data but the *active generation* of meaning through interaction with the environment. Similarly, Margiotta (2015) describes learning as an *interpretive act*, embedded in the subject's own history and situated in a dynamic process of becoming. In this sense, knowledge is always contextual, relational, and embodied (Francesconi & Tarozzi, 2012).

From this theoretical standpoint, Dweck's (2000, 2017) work represents a crucial pedagogical shift: she argues that the beliefs individuals hold about their own abilities profoundly influence the way they interpret experience, face challenges, and construct their identity as learners. Dweck distinguishes between two fundamental self-theories: the fixed mindset, in which intelligence is perceived as an immutable trait, and the growth mindset, in which intelligence and abilities can be developed through effort, practice, and persistence.

This distinction has direct implications for learning. Individuals with a fixed mindset tend to avoid challenges and perceive failure as a sign of personal inadequacy. Conversely, those with a growth mindset view difficulties as opportunities to learn, experiment, and refine strategies. As Bellantonio and Scardicchio (2023) note, a static mindset constrains the individual to "be immediately," leaving no room for *becoming*, while a growth mindset recognizes the value of processing and time in unfolding one's potential.

The two orientations differ across several dimensions, including attitude toward challenges, failure, commitment, success of others, and reflection. Table 1 summarizes these core differences as identified in the educational literature (Alioto, 2025; Bellantonio & Scardicchio, 2023; Demetrio, 2003, 2005; Dweck, 2017).

Table 1. Key elements distinguishing the fixed mindset and growth mindset.

Key-Elements	Fixed Mindset	Growth Mindset
Challenges	Avoidance	Embracement
Failure	Personal dimension	Process dimension
Commitment	Lack of intelligence	Starting point to reach the goal
Success of other	Frustration	Inspiration
Reflection	Internal monolog	Internal dialog
Focus	Performance	Process

The educational implications of these distinctions are profound. As Dewey (1977) suggests, authentic learning involves the capacity to "think about experience," transforming action into reflection and reflection into renewed action. Within this framework, a mindset operates as a formative device, mediating between self-perception and action (Margiotta, 2015). It not only determines *what* learners do but also *how* they interpret and evaluate their own development over time.

From a pedagogical point of view, the growth mindset can be considered a future-oriented disposition, grounded in what Ceruti (1986) defines as an "opening to the possible" (Bellantonio & Scardicchio, 2023). This perspective situates learning as an exploratory process rather than a fixed destination—an idea deeply aligned with the theories of resilience (Malaguti & Cyrulnik, 1999; Malaguti, 2005, 2010) and transformative learning (Mezirow, 2003). Reflection and narration become essential mediators: Demetrio (1998, 2003) highlights how autobiographical reflection enables individuals to reinterpret their experiences, transforming implicit beliefs into explicit awareness. Through narrative work, learners integrate past and present meanings while envisioning possible futures, enabling coherence between identity and change.

Pellerey (2021) further emphasizes that beliefs about one's own intelligence and abilities can shape professional identity, influencing motivation and agency. Mindset, therefore, acts as both a cognitive and existential structure: it governs how individuals attribute meaning to success and failure, and how they orient themselves toward lifelong learning. In this sense, the growth mindset is not simply a psychological trait but a pedagogical stance—a way of relating to the world and to oneself that promotes openness, transformation, and reflective self-direction.

2.2. Growth Mindset from a Neuroscientific Perspective

In recent years, neuroscience has provided a biological foundation for Dweck's theoretical construct. The principle of neuroplasticity—the brain's ability to reorganize itself by forming new neural connections throughout life—confirms that abilities and intelligence are not fixed entities but evolving systems shaped by experience. As Kleim and Jones (2008) and Boyd et al. (2010) demonstrated, the brain's structure changes through *use-dependent learning*: repeated practice strengthens synaptic connections, while disuse weakens them. These discoveries, initially observed in experimental settings with enriched environments, have profoundly influenced educational theory, highlighting the brain's inherent capacity for adaptation.

Ng (2018) showed that adopting a growth mindset activates neural networks associated with intrinsic motivation and self-regulation, producing long-term changes in brain connectivity. Similarly, studies in neuroeducation suggest that growth-oriented learners engage regions involved in error detection and cognitive flexibility, such as the anterior cingulate cortex—areas that play a critical role in adjusting strategies and fostering resilience (Botvinick et al., 2004).These findings provide empirical support for the pedagogical principle of the pedagogy of error, which reframes mistakes as valuable feedback rather than as failure.

Moreover, research in affective neuroscience has revealed that motivation and perseverance are supported by the dopaminergic system, which reinforces effort and learning through the release of dopamine during goal-oriented activities (Glimcher, 2011). This mechanism aligns closely with self-determination theory (Deci & Ryan, 2000), according to which autonomy, competence, and relatedness sustain intrinsic motivation. Emotional engagement, in turn, facilitates the consolidation of memory: as McGaugh (2018) explains, emotionally charged experiences activate the amygdala and strengthen long-term retention through noradrenergic modulation.

From an educational standpoint, these neuroscientific insights underscore that learning is not merely a cognitive process but an embodied and emotional act. Each experience of effort, reflection, and success modifies the brain's architecture, turning learning itself into a biological and reflective transformation. As Francesconi and Tarozzi (2012) and Siegel (2011) argue, education should therefore be understood as *embodied practice*, one that integrates cognition, emotion, and action.

Consequently, the growth mindset can be reconceptualized as a neuro-educational construct: it bridges psychological belief, neural adaptability, and pedagogical intentionality. Each act of reflection or perseverance becomes both a mental and neural event—a literal *repatterning* of the brain toward openness, resilience, and lifelong learning. This convergence between neuroscience and education legitimizes the design of playful, emotionally meaningful learning environments, such as *Intergalactic Growth*, that engage not only cognition but also emotion and neuroplasticity in the service of transformation.

3. A Prototype Game to Improve Consciousness of Mindsets and Promote Reflection and Perseverance

3.1. Playful Approaches and Learning

Rather than adding points or badges on top of existing activities, *Intergalactic Growth* was conceived as a compact game. This choice supports narrative mediation and reflective breaks, two requirements we consider essential for eliciting growth-mindset processes and avoiding the pitfalls of mere pointsification (Hellberg & Moll, 2023).

In this sense, in the last decade, *playful learning* has become an increasingly recognized pedagogical strategy that bridges engagement, reflection, and meaning-making. Rather than serving merely as a tool for entertainment, play represents a form of inquiry—a way of experimenting with ideas, emotions, and possibilities. As Kapp (2012) explains, gamification, understood as the use of game elements in non-game contexts, is not simply about the presence of points, levels, or rewards; its educational value depends on the intentional alignment between game mechanics and learning objectives (Antonaci et al., 2019). When designed thoughtfully, playful environments can promote deeper engagement, intrinsic motivation, and sustained learning. However, when superficial or disconnected from pedagogical purposes, gamified experiences risk devolving into what Hellberg and Moll (2023) provocatively calls *pointsification*—a system that rewards performance without fostering understanding.

The educational power of play lies in its emotional and cognitive depth. Within a well-designed playful environment, learners are invited to explore, fail, and try again—actions that mirror the developmental logic of the growth mindset (Dweck, 2017). Failure becomes an opportunity for reflection, not a marker of inadequacy. As Dicheva et al. (2015) highlight, the effectiveness of gamification depends on creating meaningful learning experiences that balance autonomy, competence, and relatedness, resonating with the motivational framework of Deci and Ryan (1985, 2000).

From a pedagogical perspective, playful learning is strongly grounded in the constructivist and enactive paradigms. According to Maturana and Varela (1980), cognition emerges through interaction between the learner and the environment: we know the world not by representing it, but by acting within it. Margiotta (2015) extends this argument to educational practice, emphasizing that learning is an interpretive and creative act—an embodied process where reflection and action continuously shape each other. This view aligns closely with *embodied education* (Francesconi & Tarozzi, 2012), which recognizes that emotion, perception, and bodily engagement are not auxiliary to cognition but integral to it.

In this sense, playful approaches operationalize the enactive paradigm by situating learners in immersive, experiential contexts that activate both emotion and cognition. The learner becomes an active protagonist, experimenting with strategies, making mistakes, and reflecting on outcomes—precisely the cycle that sustains a growth-oriented disposition. Dewey (1977) reminds us that such cycles of *experience–reflection–action* are the essence of learning; play provides a fertile space where these dynamics can unfold naturally.

Among the various components of game design, narratives play a particularly powerful educational role. They provide coherence, structure, and emotional resonance, transforming abstract concepts into lived experience. As Demetrio (1998, 2003) observes, storytelling functions as a formative practice: it connects the cognitive and affective dimensions of learning, enabling individuals to reframe their experiences and attribute meaning to them. Likewise, Mawasi et al. (2020) note that stories serve not only to transmit information but also to stimulate imagination and empathy. Within playful learning, narratives mediate between doing and understanding—allowing players to see their actions within a meaningful, symbolic framework.

However, not all games automatically generate learning. Kapp (2012) cautions that the mere presence of game mechanics does not ensure educational value. The difference lies in intentional design—that is, selecting game elements that promote reflection, perseverance, and critical thinking rather than competition or superficial achievement. When learners face challenges that are slightly beyond their comfort zone and that require creative problemsolving, they enter a state of constructive tension, which fosters both concentration and curiosity. This dynamic closely mirrors the experience of flow described by Nakamura and Csikszentmihalyi (2018), in which the balance between challenge and skill sustains deep engagement and intrinsic motivation.

From this perspective, playful learning embodies what Ceruti (1986) called a *pedagogy of the possible*: an open, exploratory process that privileges uncertainty, adaptation, and transformation. Games provide a safe microcosm in which learners can simulate life's complexity, take risks, and reimagine their own capacities without fear of real-world consequences. This interplay between experimentation, reflection, and emotion activates the learner holistically, bridging the gap between motivation and meaning. As Francesconi and Tarozzi (2012) suggest, such embodied engagement represents a complete transformation of the learner's perceptual and cognitive world—a genuine act of *becoming*.

Ultimately, the educational potential of playful learning resides in its ability to engage the learner's cognitive, emotional, and social dimensions simultaneously. When supported by a coherent narrative and reflective pauses, play transforms from a surface-level activity into a *formative experience*. In this sense, to play is to learn: it is to reflect through action, to test the boundaries of knowledge, and to construct one's own understanding of growth, challenge, and perseverance.

3.2. Game Experiences from a Neuroscientific Perspective

From a neuroscientific standpoint, playful learning engages multiple motivation and emotion systems that sustain persistence and cognitive flexibility. Deci and Ryan (2000) describe intrinsic motivation as the pleasure derived from engaging in an activity for its own sake, a phenomenon underpinned by dopaminergic activation in the brain's reward system (Glimcher, 2011). When learners experience small successes during gameplay, dopamine is released in the nucleus accumbens, reinforcing the behavior and encouraging continued effort. This mechanism explains why well-designed games are so effective in maintaining attention and engagement.

Beyond motivation, play stimulates neuroplasticity—the strengthening of neural connections through repetition and emotional arousal. Takeuchi et al. (2020) demonstrated that motivation-rich environments promote synaptic growth and long-term retention. Similarly, gamified learning contexts have been shown to improve not only academic performance but also emotional satisfaction and resilience (Koivisto & Hamari, 2019).

Emotion plays a decisive role in these processes. As McGaugh (2018) found, emotionally charged experiences activate the amygdala and release norepinephrine, which enhances memory consolidation. In game-based learning, emotional engagement thus supports the integration of cognitive and affective information, increasing the depth and durability of learning.

Many game experiences also induce a state of flow, characterized by deep concentration, enjoyment, and temporary reduction in prefrontal activity (Nakamura & Csikszentmihalyi, 2018). While this transient inhibition might seem to limit reflective control, it actually enhances the stabilization of skills and procedural memory (Sweller et al., 2019). However, to ensure that learning remains reflective, educators should design opportunities for players to periodically step out of flow, verbalize their strategies, and reconnect with conscious reasoning—thus engaging higher-order cognitive processes.

Taken together, neuroscience suggests that games engage the same circuits that underlie curiosity, emotion, and learning. They activate dopaminergic pathways that reinforce persistence, amygdalar systems that encode emotional salience, and prefrontal networks that support planning and reflection. For educational design, this means that games can serve as powerful embodied laboratories for learning—provided that they are coupled with structured moments of reflection that convert *doing* into *understanding*.

In this light, playful learning is not only compatible with neuroscience but directly supported by it: when learners play, feel, and reflect, their brains literally reorganize themselves to favor adaptability, resilience, and growth.

3.3. The Design Process of Intergalactic Growth

The prototype *Intergalactic Growth* was conceived as an educational game aimed at fostering awareness of personal mindsets while promoting reflection, perseverance, and critical thinking about the use of artificial intelligence tools such as ChatGPT. The design process was carried out in collaboration with a group of game design students under the supervision of one of the authors, who served as both mentor and researcher. Over six weeks, students engaged in iterative design meetings where they explored theoretical principles of the growth mindset and translated them into narrative and interactive mechanics.

This design stance deliberately privileges a game-based learning format—augmented by selected gamification elements—so that reflection, emotion, and feedback are integrated in a coherent, playable whole.

The game is organized into three levels—each represented by a planet—corresponding to distinct learning objectives:

- The Origin Planet introduces the player to the concept of the growth mindset. Here, the player creates an avatar and completes a self-assessment of their current mindset. A "Growth Mindset Meter" provides immediate feedback: correct responses increase the score, while incorrect ones decrease it.
- Planet Reflectia focuses on reflection and resilience. Players engage in a "shooting stars" mechanic, where each captured star unlocks a question prompting reflection on past failures and strategies for improvement.
- Planet Knowlaria addresses the critical and reflective use of ChatGPT. In this level, players interact with AI-related scenarios, answering questions that combine theoretical understanding with ethical reasoning.

The entire experience is framed by a narrative arc in which the player's mission is to become a citizen of *Intergalactic Growth*. To achieve this goal, players must demonstrate both cognitive understanding of growth mindset principles and reflective awareness of their own attitudes toward learning and technology. The game's narrative is intentionally metaphorical: traveling between planets symbolizes the personal journey of transformation from fixed to growth-oriented thinking.

Instant feedback mechanisms, visual progress indicators, and emotionally engaging storylines are combined to sustain motivation and perseverance throughout the game. However, the prototype was designed not as a final product but as a research instrument—a vehicle for exploring how playful design can translate theoretical constructs, such as the growth mindset, into embodied learning experiences.

4. Method and Materials

4.1. Research Design

The present study was framed within the Design-Based Research (DBR) methodology, which integrates theoretical development and iterative prototyping through cycles of design, implementation, and reflection (Euler, 2014). DBR was chosen because it enables the combination of empirical inquiry and practical innovation, generating context-sensitive insights that inform the design of educational interventions.

This specific phase of the project was exploratory and evaluative, aiming to understand participants' experiences with Intergalactic Growth and to identify directions for improvement. As the pilot phase of a larger design-based research (DBR) project, this study focused on testing the prototype's usability, emotional resonance, and reflective potential before conducting further iterations with adult learners in workplace contexts.marzo

A qualitative approach was selected as the most appropriate to capture the complexity of these dimensions. As Braun and Clarke (2019) argue, reflexive thematic analysis (RTA) allows researchers to identify patterns of meaning across participants' accounts, interpreting how they experience and make sense of phenomena. This approach is particularly well suited to playful learning research, where engagement and reflection are dynamic, subjective processes.

Research Questions and Hypotheses

Consistent with the exploratory nature of Design-Based Research (Euler, 2014) and the interpretive orientation of Reflexive Thematic Analysis (Braun & Clarke, 2019), this study did not seek to test statistical hypotheses but to explore how participants experienced reflection, emotion, and awareness during gameplay.

The investigation was guided by two research questions (RQs) and corresponding exploratory hypotheses (Hs):

RQ1. *How do participants experience reflection, emotion, and engagement when interacting with Intergalactic Growth?*

H1. *Gameplay will elicit moments of reflective, engagement and emotional activation consistent with the mechanisms of the growth mindset described by Dweck (2017).*

RQ2. *How do the design elements of Intergalactic Growth (narrative, challenge, feedback, and AI integration) influence participants' perceptions of learning authenticity and transferability?*

H2. *Participants will perceive narrative coherence and authentic challenges as key factors supporting motivation, self-reflection, and the transfer of learning to real-life contexts.*

These questions provided the analytical frame for data collection and coding. The thematic synthesis presented in Section 5 explicitly maps the four emergent themes onto these two research questions.

4.2. Participants and Procedure

This study involved 15 undergraduate students (aged 19–21) enrolled in a General Psychology course at Ca' Foscari University of Venice. Although the game's target audience consists of adult workers aged 50–60, this pilot phase focused on younger participants to test usability, emotional resonance, and reflective potential in a controlled academic setting.

Recruitment took place through an online call published on the university's Moodle platform. Participation was voluntary and based on two inclusion criteria:

(a) Sufficient English proficiency, since the prototype was in English;
(b) Access to a personal computer with internet connectivity.

The activity took place during a scheduled class session. After a brief introduction to the research aims, students played Intergalactic Growth individually, while non-participants worked on complementary materials about the growth mindset. Following gameplay, a semi-structured focus group was conducted with ten volunteers, while five provided short written reflections. The focus group lasted approximately one hour and was facilitated by two researchers, one moderating and one observing and taking field notes.

All participants provided informed consent prior to participation, in accordance with Ca' Foscari University's ethical standards.

4.3. Data Collection Instruments

Data collection combined focus group discussion and field observation, using a semi-structured protocol derived from two validated instruments widely used in game-based learning research:

1. The Game User Experience Satisfaction Scale (GUESS-18) (Phan et al., 2016; Keebler et al., 2020), from which two key dimensions—narrative engagement and enjoyment—were adapted to explore how players perceived immersion and meaning.
2. The Game Experience Questionnaire—Core Module (GEQ-Core) (IJsselsteijn et al., 2013), whose constructs—positive affect, negative affect, tension, and challenge—served as analytical lenses for emotional and motivational experiences during gameplay.

Participants were asked to describe their feelings, motivations, and reflections as they played, focusing on the following dimensions:

- Emotional reactions (enjoyment, frustration, tension);
- Reflective moments and mindset awareness;
- Perceptions of narrative coherence and feedback authenticity;
- Suggestions for design improvement (mechanics, ChatGPT integration, esthetic appeal).

The focus group guide encouraged open-ended discussion to capture subjective meaning-making and reduce the influence of researcher expectations. Meanwhile, field notes recorded spontaneous comments, non-verbal cues, and group dynamics to support data triangulation. Notably, GEQ-Core and GUESS-18 constructs were not administered as standardized scales; rather, they sensitized the prompts to probe experiential dimensions and were not used as outcome measures.

4.4. Data Analysis

Audio recordings were transcribed verbatim and analyzed using reflexive thematic analysis (Braun & Clarke, 2019). The six following phases were followed: (1) familiarization; (2) initial coding; (3) generating candidate themes; (4) reviewing themes; (5) defining and naming themes; (6) producing the report. Initial coding combined both deductive and inductive reasoning. Deductively, sensitizing concepts were drawn from GEQ-Core and GUESS-18 dimensions (e.g., enjoyment, tension, reflection), while inductive codes emerged directly from participants' words during familiarization. For instance, statements such as "*I realized I had never reflected on failure before*" were initially coded as reflection on failure, later merged with similar instances under the subtheme awareness and reframing. This iterative refinement followed Braun and Clarke's (2019) principle of moving from descriptive labels to interpretive themes through constant comparison and memo-writing.

NVivo 14 supported coding and visualization (e.g., node co-occurrence, matrix queries) without automating interpretation, which remained researcher-led and reflexive. To enhance trustworthiness, we used triangulation (focus-group data and field notes) and peer debriefing; we also maintained a brief reflexive memo documenting analytic decisions.

During the peer debriefing, two additional researchers not directly involved in data collection independently reviewed a selection of coded transcripts and provided feedback on code definitions and thematic grouping. Divergent interpretations were discussed in joint sessions until conceptual agreement was reached. Although formal inter-coder reliability was not computed—consistent with RTA's reflexive stance (Braun & Clarke, 2019)—these discussions enhanced credibility and transparency. Triangulation was achieved by cross-checking insights from different focus group sessions, ensuring that emotional cues observed during gameplay were consistent with participants' verbal reports.

4.5. From GEQ Categories to Thematic Clusters

An important methodological step involved translating instrument-informed dimensions into broader interpretive themes aligned with this study's pedagogical and neuroscientific focus. Specifically, we used GEQ-Core constructs (positive affect, negative affect, tension, challenge; IJsselsteijn et al., 2013) and two GUESS-18 dimensions (narrative engagement, enjoyment; Phan et al., 2016; Keebler et al., 2020) as sensitizing concepts to guide first-order coding. In addition, we included reflection as a researcher-defined analytic code to capture metacognitive talk that is central to our aims but not directly covered by the instruments. These categories informed the interview guide and early coding but did not function as standardized scales in this study.

This process exemplifies Braun and Clarke's (2019) emphasis on moving "from description to interpretation," where analytic themes represent not discrete variables but patterns of meaning emerging from participants' lived experiences.

The four final themes that emerged from this interpretive synthesis were as follows:

1. Reflective engagement through play;
2. Emotional and motivational dynamics;
3. Narrative and symbolic mediation;
4. Authenticity, challenge, and learning transfer.

To maintain transparency, Table 2 presents the mapping between original GEQ categories and emergent thematic clusters, as identified through NVivo 14.

Table 2. Mapping of GEQ/GUESS categories to emergent themes in NVivo 14.

GEQ/GUESS Category	Representative Codes in NVivo	Emergent Thematic Cluster	Interpretive Focus
Positive Affect	Enjoyment, satisfaction, curiosity	Emotional and Motivational Dynamics	Emotional activation, engagement, and flow during gameplay
Negative Affect	Frustration, boredom, irritation	Emotional and Motivational Dynamics	Ambivalence between motivation and anxiety
Tension	Pressure, self-evaluation, performance stress	Emotional and Motivational Dynamics	Perceived tension between intrinsic and extrinsic motivation
Reflection	Self-questioning, reinterpretation of failure	Reflective Engagement through Play	Awareness, introspection, and mindset reframing
Narrative Engagement	Story immersion, coherence, character attachment	Narrative and Symbolic Mediation	Emotional meaning-making and coherence of learning
Challenge	Desire for authentic feedback, adaptive difficulty	Authenticity, Challenge, and Learning Transfer	Transferability of learning and engagement through complexity

4.6. Ethical Considerations

Participants were fully informed about this study's objectives, the voluntary nature of participation, and data confidentiality. All identifying information was anonymized in transcripts and NVivo datasets.

Participants were also informed that ChatGPT functioned only as a narrative element within the prototype and did not collect or process any personal data, ensuring full compliance with research ethics and privacy standards.

5. Results

The reflexive thematic analysis conducted with NVivo 14 revealed four overarching themes and eight subthemes, reflecting participants' experiences of engagement, reflection, and emotional involvement during gameplay. These themes capture how learners interpreted Intergalactic Growth not merely as entertainment, but as an opportunity for self-reflection and awareness of their own mindsets.

The four main themes are as follows:

1. Reflective engagement through play;
2. Emotional and motivational dynamics;
3. Narrative and symbolic mediation;
4. Authenticity, challenge, and learning transfer.

Each theme is described below with illustrative quotations that exemplify participants' experiences.

5.1. Reflective Engagement Through Play

The most salient theme emerging from the analysis was the reflective quality of gameplay, particularly in the level Planet Reflectia. Participants reported that the game prompted them to reconsider their relationship with failure and success in unexpected ways.

One participant noted the following:

> *"The question about my failure took me a while to think and write something... it was a good starting point to later reflect on Growth Mindset."* (Participant 2)

Several students described this moment of introspection as unusual in a game context, noting that it created a meaningful pause for thought. Another participant observed the following:

> *"Perhaps, in that moment you realize you had never reflected on it before, and through this game you can do it."* (Participant 10)

These reflections suggest that Intergalactic Growth successfully transformed gameplay into a reflective learning space, where action was momentarily suspended to allow for metacognitive awareness. The NVivo co-occurrence matrix revealed strong associations between the nodes personal reflection, failure reinterpretation, and awareness of mindset, indicating a consistent pattern of self-analysis among participants.

This pattern resonates with the educational literature on reflective practice. Schön (1983) emphasizes that reflection transforms experience into knowledge, allowing learners to articulate tacit understandings and question habitual responses. Similarly, Demetrio (2003) describes reflection as an "inner dialogue oriented toward transformation," a definition that mirrors the reflective processes participants engaged in during gameplay.

5.2. Emotional and Motivational Dynamics

The second theme concerned participants' emotional and motivational responses to the game. The combination of visual esthetics, storytelling, and progression through different planets elicited curiosity and enjoyment. One participant remarked the following:

> *"Progression beyond different planets made the game more interesting. It's hard to pay attention for one hour doing the same thing."* (Participant 9)

The game's Growth Mindset Meter, however, produced mixed reactions. Some players appreciated the feedback as a source of motivation, while others perceived it as judgmental or evaluative:

> *"At the beginning, it's clear that if you want to get more points, you'll answer bluffing a Growth Mindset you don't have."* (Participant 1)

This ambivalence highlights a well-known tension between intrinsic and extrinsic motivation. According to Deci and Ryan (2000), external reward systems can undermine intrinsic motivation if learners perceive them as controlling rather than supportive. The NVivo code map revealed high co-occurrence between the categories motivation, judgment, and tension, suggesting that players experienced internal conflict between authentic reflection and performative behavior.

From a pedagogical standpoint, these findings suggest that, while feedback mechanisms can sustain engagement, they must be carefully designed to preserve autonomy and authenticity—core elements of a growth-oriented learning environment.

5.3. Narrative and Symbolic Mediation

The third theme emphasized the narrative dimension of the game, which participants widely appreciated for its coherence, imagination, and emotional depth. The interplanetary storyline was perceived as both engaging and metaphorically meaningful, representing a symbolic journey toward transformation and self-awareness.

One student commented the following:

> *"I like the story; it's cute, engaging. I also like the name of the Galaxy's Citizens."* (Participant 1)

Several participants proposed enriching the narrative by giving ChatGPT a more central and guiding role within the story:

> *"The mascot could be ChatGPT, looking like a robot and acting as a guide during the whole journey."* (Participant 2)

This suggestion points to the importance of narrative coherence and symbolic mediation in sustaining engagement. As Demetrio (2005) notes, stories help learners make sense of their experiences by providing interpretive frameworks that connect emotion, cognition, and identity. NVivo's visualization of node density confirmed strong interrelations between narrative immersion, emotional resonance, and reflective engagement, illustrating how storytelling supported both motivation and self-awareness.

5.4. Authenticity, Challenge, and Learning Transfer

The final theme focused on authenticity and the transferability of learning. Participants valued the game's emotional impact and reflective potential but expressed a desire for more complex challenges and adaptive feedback that could mirror real-world decision-making.

One paricipant observed the following:

> *"When I started the game, I expected to be challenged, understanding how my decisions would have made the difference at the end."* (Participant 2)

Another added the following:

> *"I know that the Growth Mindset is the winner one, but. . . how can I change for real?"* (Participant 9)

These comments reflect the need for authentic learning experiences—situations that simulate genuine dilemmas and consequences. According to Mezirow (2003), transformative learning occurs when individuals confront disorienting dilemmas that challenge existing beliefs and require reflective reconstruction of meaning. Participants' desire for greater interactivity and agency aligns with this principle, suggesting that Intergalactic Growth could enhance its impact by integrating branching narratives and dynamic feedback loops that allow learners to experience the consequences of their choices.

In NVivo, the themes authenticity, challenge, and learning transfer clustered tightly with reflection, reinforcing the idea that genuine engagement arises when learners perceive relevance and ownership over their experience.

5.5. Thematic Synthesis

The four themes are summarized in Table 3, which outlines their corresponding subthemes and core meanings.

Table 3. Summary of themes, subthemes, and core meanings.

Theme	Subtheme	Core Meaning
Reflective Engagement through Play	Reflection on personal failure; Awareness and reframing	Reflection fosters self-awareness and redefinition of failure as a learning opportunity.
Emotional and Motivational Dynamics	Enjoyment and immersion; Frustration and performance pressure	Emotions sustain engagement but may generate anxiety when feedback is perceived as evaluative.
Narrative and Symbolic Mediation	Narrative coherence; Expectation of guidance	Storytelling fosters emotional involvement and coherence in the learning experience
Authenticity, Challenge, and Learning Transfer	Desire for authentic feedback; Challenge and transformation	Meaningful challenges and authentic feedback enhance reflection and potential mindset change.

5.6. Synthesis and Interpretation

In summary, the findings indicate that Intergalactic Growth was effective in eliciting emotional engagement and reflective awareness, both of which are essential components in the cultivation of a growth mindset (Dweck, 2017). The game successfully prompted learners to reinterpret failure, question self-perceptions, and connect personal experiences with theoretical constructs.

At the same time, participants expressed the need for greater authenticity in the feedback system and for a more cohesive integration of ChatGPT as a narrative and reflective partner rather than a mere content element. These insights suggest that Intergalactic Growth already achieves the transformation of play into reflection, yet could evolve further toward a neuro-pedagogical model of learning, where emotion, challenge, and self-awareness converge to foster enduring mindset change.

6. Discussion

The findings of this study highlight the educational potential of Intergalactic Growth as a playful learning environment designed to foster reflection, perseverance, and awareness of one's mindset. Through the reflexive thematic analysis conducted with NVivo 14, it became evident that participants not only engaged with the game on a cognitive level but also experienced meaningful emotional and reflective processes. The four themes directly address the two guiding research questions introduced in Section 4.1. Themes 1 (Reflective engagement through play) and 2 (Emotional and motivational dynamics) respond to RQ1, concerning the pedagogical and neuroscientific underpinnings of the growth mindset, by illustrating how reflection and emotion operate as mechanisms of mindset change. Themes 3 (Narrative and symbolic mediation) and 4 (Authenticity, challenge, and learning transfer) address RQ2, exploring how the prototype's design features—narrative coherence, challenge, feedback, and AI integration—shape learners' engagement and potential transfer to real-world contexts. These results are consistent with the core principles of the growth mindset theory (Dweck, 2017), self-determination theory (Deci & Ryan, 2000), and reflective and transformative learning frameworks (Schön, 1983; Mezirow, 2003). One of the most significant findings concerns the reflective engagement elicited during gameplay, particularly in the Planet Reflectia level, where participants were invited to revisit personal experiences of failure. This reflection-on-action, in Schön's (1983) sense, represents a moment of self-confrontation that enables the transformation of experience into learning. As Schön explains, reflective practice transforms implicit knowledge into explicit awareness, allowing learners to reframe habitual patterns of interpretation and action. In Intergalactic

Growth, these reflective pauses were deliberately embedded within the game's narrative, functioning as pedagogical interruptions that invited metacognitive processing. The participants' responses confirm that such pauses facilitated the internalization of growth-oriented attitudes, transforming gameplay into what Demetrio (2003) and Bellantonio and Scardicchio (2023) describe as an "inner dialogue oriented toward transformation."

Furthermore, the findings align with Mezirow's (2003) concept of transformative learning, which occurs when individuals reinterpret previously held assumptions through critical reflection. The game's narrative encouraged this process by prompting learners to confront the meaning of failure and success, to reconsider their learning strategies, and to recognize that personal development is a continuous process of becoming. In this sense, Intergalactic Growth operates as a microcosm of transformative learning—an emotionally safe space where players can experiment with change before transferring it to real-life contexts.

Another key aspect emerging from the data relates to the emotional and motivational dynamics experienced by players. Participants' enjoyment and immersion confirm the potential of playful learning to engage both affective and cognitive systems, as theorized by Deci and Ryan (1985, 2000). According to self-determination theory, intrinsic motivation flourishes when three basic psychological needs—autonomy, competence, and relatedness—are satisfied.

The narrative structure of Intergalactic Growth appeared to support these needs to varying degrees. The planetary progression fostered a sense of competence and exploration, while the reflective prompts nurtured autonomy by allowing players to express their perspectives. However, the Growth Mindset Meter, which provided point-based feedback, sometimes introduced extrinsic motivational pressure, leading participants to perform strategically rather than authentically.

This finding echoes Deci and Ryan's (2000) caution that excessive external control can undermine intrinsic motivation by shifting focus from learning to performance. A similar concern is found in Margiotta's (2015) pedagogical critique of evaluative systems that prioritize outcomes over processes. The participants' ambivalence toward the scoring mechanism thus underscores the importance of designing non-evaluative feedback loops—mechanisms that reward reflection, curiosity, and perseverance rather than correctness alone.

The data also emphasize the symbolic and narrative dimensions of learning. As the participants' comments reveal, the game's storyworld functioned not only as a motivational scaffold but as a meaning-making environment in which abstract concepts such as growth and reflection were embodied in metaphors and characters. This aligns with Demetrio's (2003) theory of narrative learning, which situates storytelling as a key mechanism for connecting emotion, cognition, and identity.

The suggestion to integrate ChatGPT as a consistent narrative guide throughout the game further illustrates learners' need for symbolic coherence and dialogic mediation. As Margiotta and Zambianchi (2011) argue, educational relationships gain formative value when they provide continuity between external dialog and internal reflection—between the story that is lived and the one that is told. A more explicit integration of ChatGPT could therefore enhance the relational dimension of the game, transforming it from a didactic tool into a co-reflective partner that supports meaning construction (Jacomuzzi & Alioto, 2024). Participants' desire for more authentic challenges and adaptive feedback highlights the importance of designing game experiences that simulate real-life complexity. Several students expressed a wish to see how their decisions influenced outcomes, suggesting that they perceived the game as engaging but somewhat linear.

This need for authentic engagement resonates with Mezirow's (2003) notion of disorienting dilemmas—situations that challenge learners' assumptions and trigger reflective re-evaluation. By incorporating branching narratives or context-sensitive feedback, future iterations of Intergalactic Growth could more effectively reproduce this dynamic, enabling players to perceive the consequences of their mindset-related choices.

Authenticity also pertains to the transferability of learning beyond the game. As Bateson (1993) and Pellerey (2021) suggest, awareness of learning processes—rather than mere performance—supports the capacity to act reflectively in new situations. The game's success in eliciting metacognitive reflection thus represents an important preliminary step toward learning transfer, which future research should explore through longitudinal designs and adult populations. Finally, this study's findings can be read through a neuropedagogical lens, connecting emotional engagement, reflection, and learning to the brain's plastic and adaptive nature. As demonstrated by Kleim and Jones (2008) and Ng (2018), effortful learning and intrinsic motivation activate neural circuits involved in reward, attention, and self-regulation, strengthening synaptic connections and supporting long-term adaptability.

From this perspective, Intergalactic Growth can be understood as an environment that stimulates cognitive–emotional coupling—a condition in which reflective awareness and affective activation converge to facilitate deep learning. Francesconi and Tarozzi (2012) describe this as embodied education, where learning is not only cognitive but enacted, felt, and lived through the body and its emotions. The reflective activities embedded in the game mirror these processes by inviting players to inhabit their learning rather than merely observe it.

In sum, this study demonstrates that playful learning experiences can serve as laboratories of neuroplasticity—spaces where cognitive challenge, emotional activation, and reflective awareness interact to shape both mindset and neural adaptability. This convergence provides a compelling argument for designing educational interventions that integrate neuroscience-informed pedagogy with the creative, affective, and relational dimensions of play. From a practical standpoint, the findings inform game design principles for adult learning. Designers should (a) integrate non-evaluative, reflective feedback systems to sustain authenticity and autonomy; (b) embed branching challenges that mirror real workplace dilemmas, promoting transfer of reflection to professional contexts; and (c) consider AI agents such as ChatGPT as dialogical mentors to facilitate self-questioning and meta-cognition. These strategies could support the transfer of reflective competences, a crucial objective in lifelong and workplace learning.

7. Conclusions

This study set out to explore the educational potential of Intergalactic Growth, a prototype game designed to promote reflection, perseverance, and awareness of growth-oriented beliefs. Through a qualitative, design-based approach, it examined how playful learning experiences can elicit emotional engagement, foster self-reflection, and stimulate mindset transformation.

The thematic analysis, supported by NVivo 14, revealed that the game effectively created moments of reflective engagement, where participants paused to reconsider their relationship with failure and effort. The findings also indicated that emotional activation and narrative immersion played crucial roles in sustaining motivation and meaning-making. However, tensions emerged between intrinsic and extrinsic motivation, particularly due to the evaluative connotations of the Growth Mindset Meter. These mixed reactions underline the need for feedback systems that prioritize authenticity and autonomy, rather than control or performance (Deci & Ryan, 2000).

Finally, participants' call for greater narrative coherence and authentic challenges suggests that while Intergalactic Growth succeeded in transforming play into reflection, it can further evolve toward a more integrated, emotionally resonant, and cognitively challenging learning experience.

The results of this study confirm that playful approaches hold significant promise for adult and higher education. When intentionally designed, games can function as reflective micro-worlds that merge action, emotion, and cognition—thus enacting what Schön (1983) called "reflection-in-action." In this sense, play is not opposed to seriousness but becomes a medium for exploring the complexity of learning and personal transformation.

The reflective dimension observed during gameplay resonates with Mezirow's (2003) notion of transformative learning, in which disorienting experiences lead to shifts in meaning perspectives. By confronting players with emotionally charged yet safe spaces for failure, the game encouraged the revision of self-perceptions and the reinterpretation of limits. Furthermore, the embodied and enactive structure of the experience aligns with Francesconi and Tarozzi's (2012) model of embodied education, which conceives learning as a holistic interplay between body, mind, and environment.

For adult education, in particular, the game's focus on perseverance and self-awareness echoes Knowles' (1980) principles of andragogy, emphasizing autonomy, self-direction, and experiential learning. The findings therefore suggest that playful methodologies can meaningfully complement traditional didactics, offering learners opportunities to integrate cognitive understanding with emotional and relational awareness.

From a neuroscientific standpoint, this study supports the view that emotionally engaging and reflective experiences foster both cognitive flexibility and neuroplasticity. As Ng (2018) and Glimcher (2011) demonstrated, intrinsic motivation and reflective attention activate neural pathways associated with reward, regulation, and learning consolidation. The combination of challenge, emotion, and reflection in Intergalactic Growth thus corresponds to the very mechanisms that sustain adaptive learning processes in the brain.

In terms of design, these findings encourage the integration of neuroscience-informed principles into educational games: providing optimal challenge, emotional significance, and meaningful feedback to sustain both motivation and reflection. Moreover, the narrative structure could benefit from a stronger dialogical component, possibly by reimagining ChatGPT as an interactive mentor or reflective companion. Such a shift would not only enhance narrative coherence but also mirror the relational dynamics that characterize authentic educational interactions (Margiotta & Zambianchi, 2011).

In conclusion, Intergalactic Growth illustrates how playful learning can be mobilized as a transformative pedagogical strategy—a bridge between theory, neuroscience, and educational practice. By engaging learners emotionally and cognitively, the game translated abstract principles of the growth mindset (Dweck, 2017) into lived experiences of challenge, reflection, and perseverance.

This study demonstrates that play, far from trivializing learning, can act as a pedagogical catalyst for awareness and change. When grounded in reflective and embodied practice, playful design becomes a space where learners can experiment with transformation, rehearsing new ways of thinking and being. This need for embodied and socially situated approaches to learning echoes recent reflections on how digital technologies reshape educational relationships and reveal underlying tensions between pedagogical aims and bureaucratic practices (Jacomuzzi & Milani Marin, 2024; Milani Marin & Jacomuzzi, 2022).

In this sense, the convergence of growth mindset theory, neuroscience, and playful pedagogy opens a promising path for future educational innovation—one where the boundaries between learning, reflection, and play are not erased but creatively intertwined to foster lifelong adaptability, resilience, and growth.

Limitations

The study presents several limitations that constrain the generalizability of its findings. First, the sample size was small and composed exclusively of undergraduate students, whereas the intended target group of the game consisted of adult workers aged between 50 and 60 years. This discrepancy limits the ecological validity of the results, as age, professional experience, and cognitive–emotional maturity are likely to influence engagement and reflective learning within playful environments. Future studies should therefore involve adult participants to better examine these moderating factors. Second, the prototype was conducted in English with Italian participants. This linguistic mismatch may have introduced bias in comprehension and emotional resonance, potentially affecting players' immersion and meaning-making processes. To mitigate this limitation, subsequent iterations should include localization and cultural adaptation into multiple languages, thereby enhancing accessibility and contextual relevance. Third, the qualitative design adopted—based on reflexive thematic analysis (RTA)—did not allow for quantitative triangulation or longitudinal evaluation. Although the use of NVivo 14 supported a fine-grained exploration of themes, the absence of mixed-method integration and follow-up assessment limits the capacity to infer long-term effects. Future research could combine RTA with quantitative instruments, such as pre–post measures of mindset orientation or physiological indicators of engagement, to evaluate the durability and transferability of reflective insights observed during gameplay. Finally, further design developments could investigate adaptive and branching game mechanics, enabling player decisions to produce divergent outcomes. Integrating neuro-pedagogical feedback systems could also strengthen the alignment between cognitive, emotional, and reflective dimensions, fostering a more comprehensive educational impact. These limitations are partly inherent to this pilot phase; subsequent cycles of the broader DBR project will involve adult participants and mixed-method designs to validate and extend these preliminary findings.

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