# Behavioral Patterns of ELF Students with Different Levels of Learning Motivation in Digital Gaming Contexts

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**Abstract:** Digital game-based learning (DGBL) has been widely integrated into language education to create dynamic and interactive practice environments for English as a Foreign Language (EFL) learners. While numerous studies have examined the impact of gamification on learning outcomes, comparatively few have explored how learners' motivation levels influence their behavioral patterns within game-based learning environments. Grounded in self-determination theory, this study investigates the relationship between learning motivation and student behavior in a DGBL context. The study involved 53 sixth-grade EFL students from an elementary school in Taiwan, who were categorized into high- and low-motivation groups using a validated learning motivation scale. The results revealed distinct behavioral patterns between the two groups. High-motivation students exhibited more complete and goal-directed learning sequences, demonstrating persistence and strategic engagement. In contrast, low-motivation students often displayed fragmented behaviors and repeated unsuccessful attempts, reflecting less effective interaction with the game-based tasks. These findings underscore the critical role of learning motivation in shaping students' engagement and learning progression in DGBL environments, offering implications for designing personalized and adaptive game-based interventions.

**Keywords:** Digital game-based learning (DGBL), learning motivation, behavioral patterns, English as a foreign language (EFL)

## 1. Introduction

Digital game-based learning (DGBL) has gained prominence for promoting student engagement and motivation through interactive and immersive environments (Hwang & Zhang, 2024). Elements such as feedback, challenges, and rewards enhance intrinsic motivation and support deeper learning (Hamari et al., 2016; Subhash & Cudney, 2018). Especially in elementary education, game-based tasks help sustain attention and foster active participation. In the past decades, DGBL has been applied to language education, in particular, to provide interactive practicing contexts for EFL (English as Foreign Language) learners (Hong et al., 2025; Zhang et al., 2024).

Although gamification's impact on learning outcomes has been widely explored (Su & Cheng, 2015), fewer studies have investigated how students' motivation levels influence their behavior within games. Motivation shapes how learners respond to feedback, persist through challenges, and adopt strategies (Deci & Ryan, 2000). High-motivation students tend to be more exploratory and goal-driven, while low-motivation students may disengage or act passively, particularly after failures.

This study aims to analyze how students with varying levels of learning motivation behave in a DGBL context. Rather than focusing solely on outcomes, it explores behavioral

sequences—how students respond to success, failure, and task progression—based on their motivation levels. Findings are expected to inform personalized learning strategies in game-based environments. Fifty-three sixth-grade students from a public elementary school in Taiwan participated in this study to answer the following research questions:

(1)     What behavioral patterns do high-motivation students exhibit in a DGBL context?
(2)     What behavioral patterns do low-motivation students exhibit in a DGBL context?
(3)     How do the two groups differ in behavior transitions and learning processes?

## 2. Literature Review

Behavioral sequence analysis (BSA) reveals patterns and transitions in learners' actions during educational activities. Tools like GSEQ enable researchers to examine sequential behavior structures and are widely applied in digital and collaborative learning studies (Bakeman & Quera, 2011). Scholars have indicated that students with high motivation often demonstrate self-regulated behaviors such as strategy adjustment and goal-setting (Zimmerman, 2002). In contrast, low-motivation learners may avoid challenges or disengage when facing difficulties.

While previous studies have explored motivation through surveys and outcomes, few have analyzed how different motivation levels manifest in real-time learning behavior. This study addresses that gap using sequential analysis to examine and compare the behavioral patterns of high- and low-motivation learners in a game-based context.

## 3. Development of the Digital Contextual Game for ELF Learners

The instructional activity was developed using RPG Maker as a role-play digital game with the theme of animal habitation. The game featured interactive scenes where students interacted with a character (the "queen"), answered content-related questions, and completed mini-games to earn virtual badges. The game included interactive storytelling, habitat-based multiple-choice questions, and a badge system to represent learning achievements. In each gaming stage, players need to answer questions designed in a concept map format, linking ideas to support deeper understanding of animal habitats, as show in Figure 1.



Figure 1. Gaming scenarios

## 4. Experimental Design

### 4.1 Participants

The participants of this study were 53 sixth-grade students from a public elementary school in central Taiwan. Based on their scores from a standardized learning motivation scale (adapted from Pintrich & De Groot, 1990), students were divided into high and low-motivation groups.

### 4.2 Behavioral Coding Scheme

Students' in-game behaviors were coded using a predefined coding scheme consisting of 12 behaviors: Start Game (SG), Scene Info (SI), Answer Question (AQ), Correct Answer (CA), Wrong Answer (WA), Get Badge (GB), Retry Clear (RC), First Clear (FC), Share Knowledge (SK), Final Explain (FE), Catch Right (CR), and Catch Wrong (CW).

## 5. Results

### 5.1 Behavioral Patterns of High-Motivation Students

Figure 2 shows that high-motivation students demonstrated stronger task performance, with a higher rate of correct responses (AQ → CA: 35.93) than incorrect ones (AQ → WA: 23.01). They continued engaging with the game even after rewards (GB → SI: 27.12), indicating sustained motivation. Moreover, the correction cycle (CW → CR: 10.71; CR → CW: 18.83) and repetitive success pattern (CR → CR: 30.04) suggest active monitoring and strategy refinement. These students followed goal-oriented paths and displayed reflective, persistent learning behaviors.
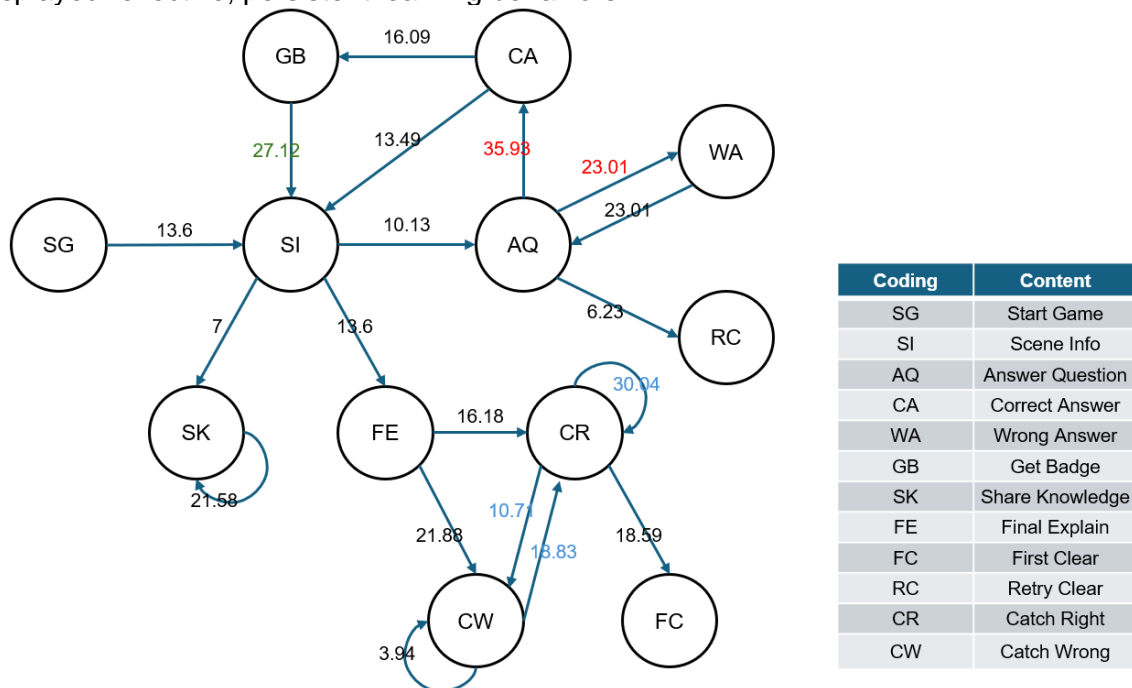


| Coding | Content |
|--------|---------|
| SG | Start Game |
| SI | Scene Info |
| AQ | Answer Question |
| CA | Correct Answer |
| WA | Wrong Answer |
| GB | Get Badge |
| SK | Share Knowledge |
| FE | Final Explain |
| FC | First Clear |
| RC | Retry Clear |
| CR | Catch Right |
| CW | Catch Wrong |

Figure 2. Behavioral transition diagram for high-motivation students

### 5.2 Behavioral Patterns of Low-Motivation Students

As shown in Figure 3, low-motivation students exhibited fewer meaningful learning sequences. The low transition rates from SI → AQ (7.61) and SI → FE (11.77) suggest reduced engagement with scene information. Although some corrective behaviors were present (CR → CR: 21.69), students frequently repeated mistakes (CW → CW: 4.41). The transition CW → FC (5.3) indicates that some task completions may have occurred by chance rather than strategy. Overall, their actions appeared reactive, fragmented, and lacking in self-regulation and sustained effort.

### 5.3 Significant Differences in Behavior Transitions

Table 1 highlights clear contrasts between the two groups. High-motivation students exhibited consistent, goal-driven behavior with active strategy use and feedback-based adjustments. In contrast, low-motivation students showed fewer connections between task steps and less evidence of learning from errors. The presence of CW → FC only in the low-motivation group suggests that they may rely on trial-and-error or luck rather than planning. These differences underscore the importance of motivation in influencing learning quality within digital game environments.
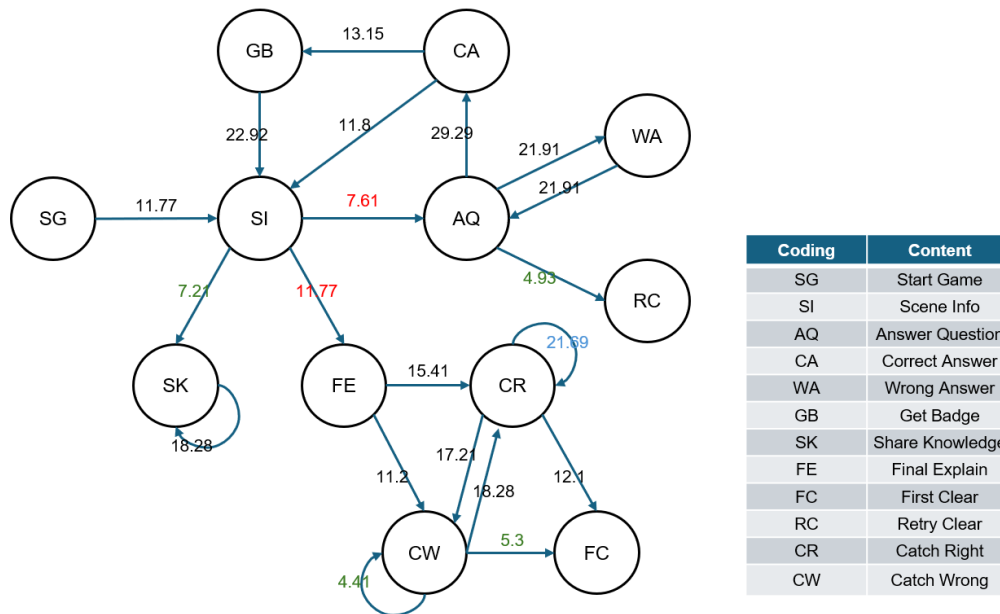
Figure 3. Behavioral transition diagram for low-motivation students

| Coding | Content |
|--------|---------|
| SG | Start Game |
| SI | Scene Info |
| AQ | Answer Question |
| CA | Correct Answer |
| WA | Wrong Answer |
| GB | Get Badge |
| SK | Share Knowledge |
| FE | Final Explain |
| FC | First Clear |
| RC | Retry Clear |
| CR | Catch Right |
| CW | Catch Wrong |

Table 1. *Comparison of behavioral patterns between high- and low-motivation students*

| Aspect | High-Motivation Students | Low-Motivation Students |
|--------|--------------------------|--------------------------|
| Task Understanding and Response | More correct responses (AQ → CA > AQ → WA); effective comprehension and strategy. | Fewer actions after prompts (SI → AQ, SI → FE); limited engagement. |
| Post-Achievement Engagement | Continued action after getting badges (GB → SI); sustained involvement. | Less follow-up or sharing (e.g., SI → SK); shallow progression. |
| Error Correction Pathways | Active correction loops (CW → CR, CR → CR); persistent and reflective. | Fewer corrections (CR → CR); more repetition (CW → CW). |
| Task Completion Patterns | Clear success paths (CR → FC); strategic and goal-driven. | FC suggests chance-based completion without correction. |
| Overall Behavior Patterns | Structured, self-regulated, and continuous learning behaviors. | Fragmented, reactive, and minimally adjusted actions. |

## 6. Discussion and Conclusions

This study employed behavioral sequence analysis (GSEQ) to examine how students with different levels of learning motivation behaved during a digital game-based learning task. These findings affirm the critical role of learning motivation in shaping students' engagement and progression in game-based learning environments. The behavioral transitions indicate that learning motivation influences not just the quantity but the quality of learners' actions in a game-based context.

High-motivation students demonstrated frequent and structured transitions, including corrective sequences such as CW → CR → CR and CR → FC, supporting self-regulated learning. These patterns align with Zimmerman's (2002) model of metacognitive learning, in which learners actively monitor performance and revise strategies. In contrast, low-motivation students tended to repeat errors or complete tasks by chance. The presence of CW → FC (5.3) may suggest task success without deliberate effort or understanding, possibly due to error-tolerant system settings. Moreover, lower frequencies of SI → AQ and SI → SK reflect their reduced willingness to engage with instructional cues or integrate knowledge.

On the other hand, several limitations should be noted. First, the sample size was relatively small and drawn from a single school, which may limit the generalizability of the findings. Second, the study focused solely on behavioral data during one specific game-based task, without incorporating qualitative insights such as students' reflections or emotional responses. Additionally, group division was based on self-reported motivation scores, which may not fully capture students' dynamic motivational states during gameplay.

Future studies could expand the sample size and include students from diverse educational settings to improve generalizability. Incorporating multimodal data—such as interviews, eye-tracking, or physiological responses—could enrich understanding of how motivation interacts with behavior. Moreover, longitudinal research could explore how motivational patterns evolve over time and across different types of learning games.

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