Proceedings of the 5th International Conference on Interdisciplinary Humanities and Communication Studies
DOI: 10.54254/2753-7064/2026.36145

The Impacts of Gamified Online Learning on Cognitive Load and Attention

Yiyi Zhen

The Education University of Hong Kong, Hong Kong, China
zhengyiyi129@163.com

Abstract. Now many online learning platforms add game-like features to their systems. Common examples include points, leaderboards, badges, progress bars, competitive modes and task challenges. Platform designers build these features mainly to get students more involved and make learning feel easier and more fun. However, people only have limited attention space and working memory capacity. Any extra information will take up cognitive resources. Gamified learning tools may either help learners study better or disturb their learning process. Compared with offline classroom study, online learning asks learners to control themselves and keep focused for longer periods. This paper puts forward a key idea: gamified online learning cannot cut learning burdens by itself. Reward and competition rules from game designs may catch learners' attention randomly and bring more external cognitive load. Only well-designed gamified elements can guide learners' attention and give useful feedback to reduce study pressure. This paper mainly discusses two core research questions. First, which online gamified features grab people's attention unexpectedly and raise external cognitive load? Second, which gamified elements help learners keep attention on learning goals and lower their study burden?

Keywords: gamification attention learning, Impact of video games on brain, Neural correlates of learning, Cognitive Scaffolding, Decision Fatigue

1. Introduction

Learning heavily depends on self-control. Learners need to manage themselves to get through boring study tasks. This process relies on goal-directed attention, which means people control their attention from top to bottom to deal with learning materials. This mental activity needs precise cooperation of different brain cortex and subcortical areas [1]. It mainly works through the dorsal frontoparietal brain network. This network prepares people for specific signals or responses and creates selective focus. More clearly, the dorsal prefrontal cortex controls attention distribution and working memory. The frontoparietal system keeps people focused on learning targets. The anterior cingulate cortex and lateral prefrontal lobe create concentrated attention to block outside distractions [2].

Games catch people's attention through stimulus-driven signals. They follow a bottom-up processing mode. Games use simple skill tests, frequent task switches and eye-catching visual

DOI: 10.54254/2753-7064/2026.36145

interfaces to create alternating attention for players. Besides, video games activate many different cortex and subcortical brain structures, as well as people's cognitive and emotional abilities [3].

We can tell the clear difference between learning and game playing. Study activities mostly use goal-directed and concentrated attention. Many game activities rely on stimulus-driven and alternating attention instead. These two modes do not belong to fully separate brain areas. They just show different ways of distributing limited attention resources.

2. Results

2.1. Cognitive load theory

Cognitive load means the total mental effort a person's working memory uses when finishing a certain cognitive task. From the view of information processing, it covers all mental resources used to code, activate, store and operate information. The core idea of this theory explores how people reach the best learning results with limited cognitive resources [4].

2.2. External cognitive load

External cognitive load refers to extra mental pressure caused by the way information is shown and unnecessary cognitive work learners have to do. It does not come from how hard the learning material itself is. Instead, it appears because of poor teaching plans or unreasonable ways to present information. This extra load takes up valuable cognitive resources and weakens teaching effects. For this reason, good teaching designs should cut down or remove such external load as much as possible [4].

We can draw a clear conclusion from the above content. Working memory has a fixed limit. When gamified features have nothing to do with learning content, they will create more external cognitive load. Learners will get distracted and their study results will become worse.

2.3. Gamified elements that increase cognitive load

Attention control and working memory link closely to prefrontal lobe functions. Making many judgments will tire the prefrontal lobe and reduce blood oxygen levels in this brain area. People with decision fatigue will lose the willingness to keep trying. When they face many choices, they tend to pick the default option directly [5]. Their learning motivation will drop as a result. If gamified designs force learners to switch attention often and stop useless signals repeatedly, the mental pressure of executive control will rise.

Table 1. Statistics of gamified elements that raise cognitive load (sorted based on literature [6-9])

	Points & Rewards	Real-time Competition	Complex Visual UI
Attention Type	Stimulus-driven attention, involuntary attention	Alternating attention, divided attention	Stimulus-driven attention, selective attention
Activated Neural Mechanisms	Alerting network	Executive control network, alerting network	Orienting and reorienting network

DOI: 10.54254/2753-7064/2026.36145

2.4. Gamified elements that cut cognitive load

Wood, Bruner and Ross put forward the core logic of cognitive scaffolding in their classic research. This method limits the freedom of learning tasks. It lets learners focus their limited attention resources on knowledge points within their ability. In this way, learners can understand knowledge before they produce learning outputs. In gamified learning, this theory offers a design idea to adjust task difficulty step by step and balance cognitive load [10].

The key to better learning is to cut useless information and free up limited working memory space. Designers should turn dopamine-driven excitement in games into executive function power for study. For example, proper gamified learning gives quick feedback without punishment to lower learners' self-check pressure. It splits difficult knowledge into small task challenges. All these small tasks stay in learners' zone of proximal development (ZPD) to keep suitable learning difficulty [11]. Visual layouts in good gamified tools guide the parietal lobe to find key content quickly and block useless signals. Such designs improve the efficiency of the executive control network and reduce judgment pressure on the prefrontal lobe.

Table 2. Statistics of gamified elements that reduce cognitive load (sorted based on literature [6-9])

	Progress Bars	Timely Feedback	Targeted Small Tasks
Attention Type	Goal-directed attention, sustained attention	Selective attention	Concentrated attention, sustained attention, goal-directed attention
Activated Neural Mechanisms	Frontoparietal control network, executive control network	Executive control network	Frontoparietal control network, dorsal attention network

If the visual layout of gamified learning brings extra distracting signals, external cognitive load will increase. Higher external load means fewer mental resources left for learners to understand, combine and use knowledge. Designers must balance game features and learning needs carefully during course development.

3. Conclusion

This paper states that gamified online learning brings two opposite effects on cognitive load and attention. Adding game rules to learning does not equal lighter study pressure or lower cognitive load. As a result, the core standard for designing gamified online courses is whether these game features serve learning goals and help learners hold goal-directed attention. Bad gamified designs only create extra distracting signals and add study burdens. This research has clear limits. All analysis in this paper relies on theoretical discussion, without support from real experiment data or cases of specific online learning platforms. Few multimodal test data such as EEG, fNIRS and fMRI are used to explain how gamified online learning changes cognitive load and attention. Besides, researchers should also think about whether learners will rely too much on this kind of gamified online learning aid.

AI usage statement

I make a serious statement here. All literature materials, research contents and analysis views in this paper are collected and written independently by myself. I finished the full paper outline by my own hand. Artificial intelligence only helps polish the outline structure. Translation software assists with

DOI: 10.54254/2753-7064/2026.36145

parts of foreign literature translation. Later I check and rewrite every sentence by myself. All final opinions, logic and content of this paper are true and meet academic rules.

References

[1] Kahn, A. (2020). *Behavioral and neural correlates of graph learning*. University of Pennsylvania, ProQuest Information and Learning Co. (Doctoral dissertation).
[2] Management Association, I. R. (2018). *Applications of neuroscience: Breakthroughs in research and practice* (1st ed.). IGI Global. https://doi.org/10.4018/978-1-5225-5478-3
[3] Smirni, D., Garufo, E., Di Falco, L., & Lavanco, G. (2021). The playing brain. The impact of video games on cognition and behavior in pediatric age at the time of lockdown: A systematic review. *Pediatric Reports, 13*(3), 401–415. https://doi.org/10.3390/pediatric13030047
[4] Sweller, J. (2023). The development of cognitive load theory: Replication crises and incorporation of other theories can lead to theory expansion. *Educational Psychology Review, 35*(4), Article 95. https://doi.org/10.1007/s10648-023-09817-2
[5] Pignatiello, G. A., Martin, R. J., & Hickman, R. L. (2020). Decision fatigue: A conceptual analysis. *Journal of Health Psychology, 25*(1), 123–135. https://doi.org/10.1177/1359105318763510
[6] Cohen, R. A. (1993). *The neuropsychology of attention*. Plenum Press.
[7] Cohen, R. A. (2011). Attention. In J. S. Kreutzer, J. DeLuca, & B. Caplan (Eds.), *Encyclopedia of Clinical Neuropsychology*. Springer.
[8] Zhang, X. L., & Fang, F. (2017). Bottom-up attention and its neural mechanisms. *Acta Psychologica Sinica, 23*(2), 99–109.
[9] Corbetta, M., & Shulman, G. L. (2002). Control of goal-directed and stimulus-driven attention in the brain. *Nature Reviews Neuroscience, 3*(3), 201–215.
[10] Wood, D., Bruner, J. S., & Ross, G. (1976). The role of tutoring in problem solving. *Journal of Child Psychology and Psychiatry, 17*(2), 89–100. https://doi.org/10.1111/j.1469-7610.1976.tb00381.x
[11] Jeong, J., & Frye, D. A. (2025). Approximating the ZPD? Young children's judgements of appropriate task level for learning. *British Journal of Developmental Psychology, 43*(1), 37–65. https://doi.org/10.1111/bjdp.12519