

Author Response to Reviewers

Dear Editor,

We would like to sincerely thank you and the reviewers for the careful and constructive evaluation of our manuscript entitled **“Gamification as an Information Technology Tool for Enhancing Cognitive Skills and Critical Thinking: A Systematic Review.”**

We greatly appreciate the time and expertise invested in reviewing our work. The comments and suggestions provided have been instrumental in strengthening the manuscript, particularly with regard to the clarity of the research contribution, theoretical grounding, methodological transparency, and the articulation of implications, limitations, and future research directions.

Below, we provide a detailed, point-by-point response outlining how each comment has been addressed in the revised manuscript.

Response to Reviewer 1

We sincerely thank Reviewer 1 for the positive evaluation of the manuscript and for recognizing the rigor of the PRISMA-based methodology, the representativeness of the selected literature ($n = 100$), and the transparency ensured through the public GitHub repository. We are grateful for the constructive **minor** suggestions, all of which have been carefully addressed in the revised version.

Citation support for the Introduction

The Introduction has been revised to include authoritative references supporting claims related to digitalization trends in education and the current state of gamification research. In particular, references to international policy and analytical reports (OECD; UNESCO) have been added to substantiate broader educational transformation claims, while foundational and highly cited academic studies (e.g., Dicheva et al.; Hamari et al.) have been incorporated to ground the discussion of gamification within established scholarly literature. These additions strengthen the conceptual framing and clarify the positioning of the research gap.

Justification for the 2020–2025 timeframe

The rationale for selecting the 2020–2025 timeframe has been further strengthened through the inclusion of authoritative references. The revised manuscript clarifies that while earlier work on artificial intelligence in education primarily articulated conceptual frameworks and long-term expectations (e.g., Holmes et al., 2019), the period from 2020 onward marks a transition toward empirically grounded, large-scale implementations enabled by advances in generative AI, learning analytics, and adaptive systems (e.g., Kasneci et al., 2023). References to OECD and UNESCO reports further support this methodological choice by highlighting the rapid deployment of AI-driven educational technologies during this period.

Correction of Figure 2 (PRISMA diagram)

The superfluous graphical marker identified in the Screening stage of the PRISMA diagram has been removed. The figure has been corrected to ensure visual accuracy and full compliance with PRISMA reporting standards.

Deepening the Discussion and future outlook

Sections 6 (Discussion) and 7 (Future Directions) have been substantially expanded and refined. Additional high-impact literature beyond the reviewed sample has been integrated to situate the findings within a broader scholarly context. In response to the reviewer's recommendation, the revised Discussion explicitly highlights the emerging role of **Generative AI (GenAI)** in gamified learning environments, including applications such as dynamic narrative generation, personalized feedback, adaptive assessment, and real-time learner support. These developments are now clearly positioned as a high-priority direction for future research.

Response to Reviewer 2

We sincerely thank Reviewer 2 for the detailed and thoughtful critique. The comments provided have led to substantial improvements in the articulation of the research gap, the development of the theoretical framework, methodological transparency, and the overall organization and coherence of the manuscript.

Clarification of research gap, aims, and contribution

The Abstract and Introduction have been thoroughly revised to clearly articulate the research gap, the aims of the study, and its contribution to the literature. The revised text explicitly positions gamification as an **information technology–enabled sociotechnical learning system**, rather than a standalone instructional technique, and highlights the novelty of integrating cognitive, motivational, technological, and theoretical perspectives within a single systematic review.

Strengthening of the theoretical framework

The theoretical foundation of the manuscript has been substantially strengthened and explicitly integrated into the analysis and interpretation of findings. The review is now grounded in established theories from educational psychology and learning sciences, including **Self-Determination Theory**, **Cognitive Load Theory**, **Flow Theory**, and a **sociotechnical systems perspective**. This integrated framework provides a coherent conceptual basis for synthesizing the reviewed evidence and interpreting the cognitive and motivational mechanisms underlying gamified learning environments.

Improved methodological transparency

The Methods section has been substantially revised to enhance transparency and reproducibility, in line with best practices for systematic literature reviews. The revised section now clearly describes the research design, data sources, search strategy, screening and sampling procedures, inclusion and exclusion criteria, and data extraction and analysis processes. This level of detail allows readers to independently assess how the findings were obtained and ensures methodological rigor appropriate for a systematic review.

Reorganization of argumentation and conclusions

The Discussion and Conclusion sections have been restructured using clearer subheadings aligned with the study's research questions. Redundant statements have been removed, and major claims are now consistently supported by empirical evidence from the reviewed studies or by established theoretical frameworks. This reorganization improves logical flow and strengthens the coherence of the manuscript's argumentation.

Revision of Data Availability and Ethics statements

The Data Availability and Ethics/Informed Consent statements have been revised to accurately reflect the nature of this work as a systematic literature review. The revised Data Availability statement clarifies that **no primary human data were collected** and specifies which review-related materials (e.g., PRISMA documentation, search strategies, and data extraction templates) are publicly available via a repository, in accordance with the journal's policies and transparency standards.

Strengthening implications, limitations, and future directions

The Discussion and Conclusion now more explicitly integrate the findings within the theoretical framework, outline practical and theoretical implications, discuss important limitations, and present a coherent and forward-looking research agenda. Particular attention is given to ethical considerations, equity and inclusion, and the long-term sustainability of AI-enhanced gamified learning systems.

Response to the Editor

In line with the editor's recommendations, the manuscript has been carefully revised to ensure that the results are accurately reported, any overstated conclusions have been moderated, and the limitations of the study are clearly articulated. Supporting materials related to the systematic review methodology, including PRISMA documentation and data extraction materials, are available to support transparency and verification.

We sincerely thank the editor and reviewers for their valuable feedback and the opportunity to improve our manuscript. We believe that the revisions have significantly strengthened the clarity, rigor, and contribution of the paper, and we hope that it is now suitable for publication.

Kind regards,

Aray Kassenkhan