



## Introduction to the Special Issue on GaLA Conf 2022

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DOI:10.17083/ijsg.v10i4.714

This International Journal of Serious Games special issue is dedicated to the selected and extended best papers of the 2022 edition of the GALA conference. Professor Kristian Kiili and his team at Tampere University in Finland organized this edition of the conference.

Authors of seven highly-rated conference submissions were invited to submit extended papers for this special issue. After peer review process, five extended papers were accepted. These papers show how game-based learning and serious games continue to evoke extensive research efforts, and clearly demonstrates the breadth of different research approaches used in game-based learning. With such an open-minded approach, it is possible not only to advance our knowledge of game-based learning but also to contribute significantly to the understanding of the factors that influence human learning.

“*Toward a framework for assessing the effectiveness of adaptive digital games*”, by Vanbecelaere et al. [1] presents a conceptual framework for a broad evaluation of the effectiveness of adaptive digital games. The developed framework integrates insights from a wide array of theoretical frameworks concerning learner differences, adaptivity, and measured learning outcomes. The authors utilize the framework to describe recent intervention studies on the effectiveness of adaptive digital games in the context of K-12 education. The framework has the potential to make a significant contribution to the adaptive game-based learning literature by guiding the summarization of the study results and harmonizing the terminology used to describe study designs.

“*Demystifying the Relations of Motivation and Emotions in Game-Based Learning: Insights from Co-Occurrence Network Analysis*”, by Kiili et al. [2] investigates epistemic emotions (i.e., curiosity, enjoyment, confusion, and boredom) and their relations to motivational constructs. The results show that when students (n = 131) used the Antidote COVID-19 health literacy game they reported significantly higher levels of positive epistemic emotions than negative ones. The utilized co-occurrence analysis revealed that high-intensity flow experience, situational interest, and satisfaction most often co-occurred with positive epistemic emotions. It was also discovered that high-intensity flow can be experienced without high situational interest in the topic. This finding suggests that gameplay can engage students even though the learning topic does not interest them. This study extends our understanding by demonstrating the usefulness of using co-occurrence network analysis in game-based learning research, and by suggesting that understanding different dimensions of engagement in game-based learning requires measures of, at least, flow experience, situational interest, and epistemic emotions.

“*Mathematical game performance as an indicator of deliberate practice*” by McMullen et al [3] investigates whether the Number Navigation Game could help promote deliberate practice in mathematics and whether students’ adaptive number knowledge, perceived challenge, flow, and math interest is associated with their game performance. The authors determined that a four-profile growth mixture model was the most appropriate to capture students’ (n = 214) relative performance in the game. The results revealed a group of students who improved their performance throughout the game achieved larger learning gains than the other groups, despite initially having lower-than-average performance. Interestingly, students in this group also reported low levels of flow. This suggests that their interaction with the game may be aligned with deliberate practice. These results extend our understanding by showing that game-based learning can be used to foster deliberate practice-like behavior.

“*Museum Games and Personal Epistemology: A Study on Students’ Critical Thinking with a Mixed Reality Game*”, by Morard et al. [4] investigates students’ use of information in a mixed-reality game, Geonome, designed to extend the learning experience of students’ museum visits. The aim of the game was to provoke students to critically assess information, for example by presenting misinformation. A qualitative research approach was applied to examine students’ critical thinking, interactions, and beliefs about knowledge and knowing (i.e., personal epistemology). The findings suggest that students have different personal epistemologies that affect their information processing in game-based learning and that personal epistemologies evolve during the use of game-based learning. These results suggest that game-based learning can be used to promote active information processing and critical thinking, but also shows how individual differences in personal epistemology can hinder this.

“*Implementing Deep Reinforcement Learning (DRL)-based Driving Styles for Non-Player Vehicles*” by Forneris et al. [5] presents a novel method for improving the behavioral planning of non-player vehicles. The proposed method is based on deep reinforcement learning and reduces the number of training steps required to achieve “human-like”, high-level decision-making, and different driving styles. The results of the study show that compared to a low-level decision-making approach, the proposed method performs better both in terms of safety and speed. In addition, different driving behaviors of non-player vehicles can be implemented relatively easily using this method. By providing deep insights into an effective and efficient approach to non-player vehicle training, the information and experience presented in the article can be valuable to game designers regardless of their serious game development environment.

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