Preface: Challenges and New Directions in Artificial Intelligence for Human-Game Interaction

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Abstract

This volume includes the papers presented at AI4HGI '25, the First Workshop on Artificial Intelligence for Human-Game Interaction in Bologna, at the European Conference of Artificial Intelligence '25. The workshop aimed to discuss open problems, challenges and new research directions in the use of Artificial Intelligence to shape and improve the interaction between humans and games.

Keywords

Artificial intelligence, games, digital games, Human-Computer Interaction

1. Introduction

Artificial Intelligence (AI) is increasingly transforming the landscape of Human-Game Interaction (HGI), offering new ways to model, mediate, and enhance the interplay between humans and virtual environments. AI enables systems to interpret and adapt to players' behaviors, emotions, and intentions, thereby shaping interactions that are more responsive, immersive, and meaningful [1, 2].

Once limited to optimizing game mechanics, solving strategic problems, or controlling non-player characters (NPCs) through classical techniques such as search algorithms [3], rule-based systems [4], and finite state machines [5], AI has progressively evolved into a comprehensive paradigm capable of influencing every layer of gameplay. From early applications in pathfinding [3] and opponent modeling [6] to the use of machine learning for procedural content generation [7] and adaptive storytelling [8], AI has moved from being a background mechanism to a central component actively shaping the interactive experience.

At the same time, digital games have gained increasing importance as platforms for learning [9], training [10], and behavior change [11]. Beyond entertainment, serious games are now employed in education [12], health promotion and rehabilitation [13], and behavior change interventions [14], demonstrating their potential to foster motivation, engagement, and self-regulation through play. This growing relevance has led to a convergence between game studies, artificial intelligence, and human-computer interaction, where researchers investigate how intelligent systems can support cognitive and emotional processes, personalize challenges, and sustain long-term engagement.

By leveraging player modelling, AI now enables games to respond dynamically to players' cognitive and affective states, tailoring their content, feedback, and difficulty to individual needs [2]. Moreover, advances in procedural content generation [7], dynamic storytelling [15], and autonomous NPC behavior

Proceedings of AI4HGI '25: the First Workshop on Artificial Intelligence for Human-Game Interaction, at the 28th European Conference on Artificial Intelligence (ECAI '25), Bologna, October 25-30, 2025

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[16] are expanding the expressive and interactive capabilities of games, enabling them to deliver experiences that are tailored and continuously evolving. AI is thus not only a tool for automation, but a mediator of creativity and interaction, capable of reimagining the boundaries of human-game experience.

However, despite the rapid progress in this area, numerous open challenges and research questions remain. A central issue concerns understanding how AI can model the richness and unpredictability of human behavior, emotions, and intentions without reducing them to simplified computational abstractions. As games become increasingly mediated by intelligent systems, researchers face the challenge of defining what constitutes meaningful interaction between humans and AI, for example, how agency, collaboration, and creativity can be shared between player and system.

Further challenges emerge in understanding the cognitive and social dimensions of AI-driven interaction: how players perceive and trust AI-controlled entities; how adaptive or generative systems influence learning, attention, and motivation; and how AI might shape collective play, cooperation, or competition among human players. There is also a need to establish frameworks for evaluating user experience in AI-mediated contexts, where dynamic adaptation and procedural generation make reproducibility and comparability difficult.

Addressing these questions also requires a stronger integration of perspectives from disciplines beyond computer science, such as psychology, human-computer interaction, and design studies, to better inform how intelligent systems are conceived, evaluated, and aligned with human experience.

Ethical and epistemic questions add another layer of complexity. As AI systems gain autonomy in influencing user behavior or generating narrative and aesthetic content, concerns arise regarding transparency, authorship, accountability, and bias [17]. Moreover, the long-term psychological and behavioral effects of continuous interaction with adaptive or generative systems are still poorly understood.

At the same time, the growing adoption of generative AI [18] and reinforcement learning [19] opens both opportunities and risks. These technologies have the potential to create more natural, expressive, and context-aware interactions but also introduce new challenges related to control, explainability, and the preservation of human intent in co-created experiences.

Looking forward, the emergence of Large Language Models (LLMs) offers unprecedented potential for creating natural, context-aware, and conversational forms of interaction in games [20]. Yet, these models also bring new risks: unpredictability, lack of factual grounding, and ethical challenges in shaping user experience and behavior. Future research will need to balance innovation with responsibility, seeking frameworks that promote explainable, inclusive, and value-sensitive AI within game environments.

This workshop on Artificial Intelligence for Human-Game Interaction brings together researchers and practitioners from human-computer interaction, game studies, AI, and psychology to discuss these opportunities and challenges. It aims to advance understanding of how AI can enrich human-game interaction across different domains and to outline future directions for responsible, meaningful, and human-centered AI in digital games.

2. Papers Presented at the Workshop

The workshop addressed the aforementioned topics of interest. The organizing committee received eleven papers and ten papers were accepted into the workshop proceedings. A short summary of each contribution is described below.

In “Sophia Project: Enhancing Player Immersion with Intelligent Autonomous NPCs in 2D RPGs”, Chelli and Batista present an intelligent NPC system for 2D role-playing games developed in Unity. The proposed NPC, Sophia, integrates reinforcement learning for adaptive behavior, voice recognition for emotional and contextual command interpretation, and the ChatGPT API for dynamic dialogue generation. Supported by recurrent neural networks for perception and memory, Sophia also manages relationship tracking and contextual memory to enrich player interaction. A user study with 30 participants showed that Sophia significantly increased immersion, adaptability, and believability

compared to conventional scripted NPCs.

In “Genetic Algorithms and Reinforcement Learning to Develop Agents for a Fighting Video Game”, Matera and Basile explore three AI approaches for creating adaptive opponents in fighting games. The first agent combines a Genetic Algorithm with Monte Carlo Tree Search in a hierarchical hybrid strategy, while the other two employ Linear Q-Learning-one with offline training and one with online learning. The authors also test self-play and evolutionary training through Genetic Algorithms, and introduce a customized variant of QDagger for policy learning. A user study comparing the agents indicates that the online-learning model provides the most engaging and satisfying player experience.

In “A Visual Novel for Educating to Identify Toxic and Abusive Behaviours in Human Relationships”, Toma et al. present an educational visual novel designed to raise awareness about toxic and abusive relationship dynamics. The game engages players through interactive storytelling, real-time dialogues powered by a LLM, and branching choices that mirror real-life emotional scenarios. By placing players in the protagonist’s role, the system encourages reflection on personal perceptions of relationships and helps identify warning signs of harmful behavior. The work demonstrates how narrative-driven gameplay can effectively combine entertainment and social education.

In “FabulAI: Artificial Intelligence for Storytelling in Italian Narrative Adventures”, Cosmai et al. introduce FabulAI, a Telegram-based conversational system that enables users to create interactive stories in Italian using LLMs, specifically open-weight models such as LLaMA-3. The system combines guided storytelling with generative text capabilities to support accessible narrative creation for non-expert users. A user study with 31 participants, evaluated through the Game Experience Questionnaire (GEQ), revealed strong engagement, immersion, and enjoyment, suggesting that FabulAI effectively positions AI as a creative collaborator in interactive storytelling.

In “Exploring the Opportunities and Risks of Generative AI for Game Development: Insights from the Belgian Game Industry”, Daneels investigates how game developers perceive and use generative AI (GenAI) tools in professional practice. Through in-depth interviews with 20 Belgian developers, the study reveals a generally cautious or skeptical attitude toward GenAI, which is viewed as useful mainly for technical and supportive tasks such as coding, concept art, and prototyping, rather than for creative design. Participants expressed concerns about quality, employment impact, and the unpredictability of AI-generated content, particularly in player interactions. The paper highlights the tension between GenAI’s potential to assist development and the ethical, professional, and creative challenges it introduces.

In “Once Upon a Time There Was a LLM that Could Write a Story: A Study on Human-AI Interaction Through Text-Based Video Games”, Doukeris et al. investigate how players perceive and evaluate AI-generated narratives in interactive text-based games. Drawing inspiration from the Turing test, the authors conduct two experiments comparing human-written and AI-generated stories while examining how textual complexity affects player judgments. Results indicate that participants often struggle to distinguish between human and AI authorship, with simpler texts more likely perceived as human-written. Younger players showed greater acceptance of AI storytelling, highlighting both the promise and current creative limitations of LLMs in narrative game design.

In “Towards LLM-Agents That Play Dungeons & Dragons Using Iterative Prompting”, Joshi et al. explore the use of LLM agents as substitutes for human players in tabletop role-playing games such as Dungeons & Dragons. Using the Concordia framework to simulate multi-agent dialogue, the authors employ iterative prompting to enhance narrative coherence, collaboration, and task progression across different campaign settings. Annotated transcripts reveal that this approach improves agents’ adherence to story context and cooperative behavior. The study highlights the potential of LLM-agents as interactive participants in narrative-driven games and outlines future directions for autonomous role-playing AI.

In “Where Does Value Take Shape? An AI-Human Serious Game Design Experiment on the Poème Électronique”, Murtas and Lombardo investigate how cultural heritage values can emerge through the use of generative AI in serious game design. Focusing on Edgar à GoGo, a game inspired by Edgar Varèse’s Poème Électronique, the authors employ ChatGPT within the Co.Lab framework to co-create the game concept, followed by a human-guided prototyping phase. Expert evaluations

revealed partial alignment between the AI-generated design and the original artwork's values, alongside notable omissions. The study proposes a hybrid, reflective approach to value-sensitive game design, emphasizing expert curation as key to refining cultural meaning in AI-assisted creativity.

In "Diamonds in the Rough: Transforming SPARCs of Imagination into a Game Concept by Leveraging Medium-Sized LLMs", Geheeb et al. explore the potential of medium-sized LLMs to support early-stage game design. The authors identify ten key elements of strong game concepts and use ChatGPT to generate thirty initial game ideas. LLaMA 3.1, Qwen 2.5, and DeepSeek-R1-are then prompted to evaluate these ideas according to the identified elements. Comparative analysis shows that DeepSeek-R1 provides the most consistently useful feedback, albeit with some variability. A pilot study with ten storytelling students further demonstrates that integrating DeepSeek-R1 into early project stages enhances concept refinement, with participants reporting high-quality outputs and interest in continued use. The study highlights the promise of medium-sized LLMs for early game design support, while noting the need for improved prompting strategies to enhance reliability and effectiveness.

Finally, in "Towards Piece-by-Piece Explanations for Chess Positions with SHAP", Spinnato investigates methods to make chess engine evaluations more interpretable. The study adapts SHAP (SHapley Additive exPlanations) to attribute a position's evaluation to individual pieces on the board. By systematically ablating pieces and treating them as features, the approach computes additive, per-piece contributions that are locally faithful and human-interpretable. Inspired by traditional chess pedagogy, where players mentally assess positions by removing pieces, this method bridges classical reasoning and modern explainable AI. The study highlights potential applications in visualization, player training, and engine comparison, and provides code and data to support further research in interpretable chess AI.

In sum, the papers accepted in the workshop depict a landscape where Artificial Intelligence intersects with game design, creativity, and human experience. They range from technical explorations of reinforcement learning and evolutionary algorithms for adaptive agents, to the use of Large Language Models for narrative generation, dialogue systems, and autonomous gameplay. Other contributions examine AI's role in education, cultural heritage, and value-sensitive design, as well as the perceptions, opportunities, and risks emerging from its adoption in the game industry. Collectively, these studies illustrate the growing diversity and maturity of research at the intersection of AI and human-game interaction, while pointing toward future challenges in creativity, ethics, and human-centered design.

Declaration on Generative AI

During the preparation of this work, the author(s) used Deepl and Grammarly in order to: Grammar and spelling check. After using these tool(s)/service(s), the author(s) reviewed and edited the content as needed and take(s) full responsibility for the publication's content.

References

[1] G. N. Yannakakis, J. Togelius, Artificial Intelligence and Games, 2025. https://gameaibook.org.

[2] R. Hare, Y. Tang, Player modeling and adaptation methods within adaptive serious games, IEEE Transactions on Computational Social Systems 10 (2023) 1939–1950. doi:10.1109/TCSS.2022.3203926.

[3] A. Botea, B. Bouzy, M. Buro, C. Bauckhage, D. Nau, Pathfinding in Games, in: S. M. Lucas, M. Mateas, M. Preuss, P. Spronck, J. Togelius (Eds.), Artificial and Computational Intelligence in Games, volume 6 of *Dagstuhl Follow-Ups*, Schloss Dagstuhl – Leibniz-Zentrum für Informatik, Dagstuhl, Germany, 2013, pp. 21–31. URL: https://drops.dagstuhl.de/entities/document/10.4230/DFU.Vol6.12191.21. doi:10.4230/DFU.Vol6.12191.21.

[4] M. Gallagher, A. Ryan, Learning to play pac-man: an evolutionary, rule-based approach, in: The 2003 Congress on Evolutionary Computation, 2003. CEC '03., volume 4, 2003, pp. 2462–2469 Vol.4. doi:10.1109/CEC.2003.1299397.

[5] S. Saini, P. W. H. Chung, C. W. Dawson, Mimicking human strategies in fighting games using a data driven finite state machine, in: 2011 6th IEEE Joint International Information Technology and Artificial Intelligence Conference, volume 2, 2011, pp. 389–393. doi:10.1109/ITAIC.2011.6030356.

[6] A. M. Quadir, M. A. Khder, Exploring the potential of a.i.-driven opponents in video games, in: 2022 ASU International Conference in Emerging Technologies for Sustainability and Intelligent Systems (ICETSIS), 2022, pp. 464–469. doi:10.1109/ICETSIS55481.2022.9888909.

[7] N. Shaker, J. Togelius, M. J. Nelson, Procedural Content Generation in Games, 1st ed., Springer Publishing Company, Incorporated, 2016.

[8] E. S. de Lima, B. Feijó, A. L. Furtado, Adaptive storytelling based on personality and preference modeling, Entertainment Computing 34 (2020) 100342. URL: https://www.sciencedirect.com/science/article/pii/S187595211930076X. doi:https://doi.org/10.1016/j.entcom.2020.100342.

[9] J. P. Gee, Games for learning, Educational Horizons 91 (2013) 16–20. URL: https://doi.org/10.1177/0013175X1309100406. doi:10.1177/0013175X1309100406. arXiv:https://doi.org/10.1177/0013175X1309100406.

[10] A. De Gloria, F. Bellotti, R. Berta, Serious games for education and training, International Journal of Serious Games 1 (2014).

[11] T. Baranowski, R. Buday, D. I. Thompson, J. Baranowski, Playing for real: Video games and stories for health-related behavior change, American Journal of Preventive Medicine 34 (2008) 74–82.e10. URL: https://www.sciencedirect.com/science/article/pii/S0749379707006472. doi:https://doi.org/10.1016/j.amepre.2007.09.027.

[12] R. E. Mayer, Computer games in education, Annual Review of Psychology 70 (2019) 531–549. URL: https://www.annualreviews.org/content/journals/10.1146/annurev-psych-010418-102744. doi:https://doi.org/10.1146/annurev-psych-010418-102744.

[13] C. Vieira, C. Ferreira da Silva Pais-Vieira, J. Novais, A. Perrotta, Serious game design and clinical improvement in physical rehabilitation: Systematic review, JMIR Serious Games 9 (2021) e20066. URL: https://games.jmir.org/2021/3/e20066. doi:10.2196/20066.

[14] R. Orji, R. L. Mandryk, J. Vassileva, Improving the efficacy of games for change using personalization models, ACM Trans. Comput.-Hum. Interact. 24 (2017). URL: https://doi.org/10.1145/3119929. doi:10.1145/3119929.

[15] E. S. de Lima, B. Feijó, A. L. Furtado, Player behavior and personality modeling for interactive storytelling in games, Entertainment Computing 28 (2018) 32–48. URL: https://www.sciencedirect.com/science/article/pii/S1875952118300120. doi:https://doi.org/10.1016/j.entcom.2018.08.003.

[16] M. Y. Lim, J. Dias, R. Aylett, A. Paiva, Creating adaptive affective autonomous npcs, Autonomous Agents and Multi-Agent Systems 24 (2010) 287–311. doi:10.1007/s10458-010-9161-2.

[17] D. Melhart, J. Togelius, B. Mikkelsen, C. Holmgård, G. N. Yannakakis, The ethics of ai in games, IEEE Transactions on Affective Computing 15 (2024) 79–92. doi:10.1109/TAFFC.2023.3276425.

[18] S. A. Alharthi, Generative ai in game design: Enhancing creativity or constraining innovation?, Journal of Intelligence 13 (2025). URL: https://www.mdpi.com/2079-3200/13/6/60. doi:10.3390/jintelligence13060060.

[19] G. Lample, D. S. Chaplot, Playing fps games with deep reinforcement learning, Proceedings of the AAAI Conference on Artificial Intelligence 31 (2017). URL: https://ojs.aaai.org/index.php/AAAI/article/view/10827. doi:10.1609/aaai.v31i1.10827.

[20] R. Gallotta, G. Todd, M. Zammit, S. Earle, A. Liapis, J. Togelius, G. N. Yannakakis, Large language models and games: A survey and roadmap, IEEE Transactions on Games (2024) 1–18. doi:10.1109/TG.2024.3461510.