Towards AI-assisted Board Game-based Learning: Assessing LLMs in Game Personalisation

Andrea Tinterri[1], Federica Pelizzari[2], Giordano Vignoli[3], Francesco Palladino[4] and Marilena di Padova[5].

[1]IUL Telematic University, Florence, Italy.
[2]Catholic University of the Sacred Heart, Milan, Italy.
[3]IESS, Istituto Europeo Studi Superiori, P.zza Prampolini, 2/A, 42121 Reggio Emilia, Italy.
[4]University of Modena and Reggio Emilia, Via Università 4, 41121 Modena, Italy.
[5]University of Foggia, Via Arpi 176, Foggia, Italy.

a.tinterri@iuline.it
federica.pelizzari@unicatt.it
giordano.vignoli@gmail.com
fr.palladino90@gmail.com
marilena.dipadova@unifg.it

Abstract: Board games are used in different educational settings to promote acquisition of disciplinary content, soft skills, foster engagement towards learning content, and sustain motivation. However, designing and conducting effective educational activities with board games requires instructional design skills, knowledge of games, as well as the ability to align the player's internal goals with the learning objectives. Board game-based learning (bGBL) design includes choosing appropriate games and personalising them to better fit with the educational setting and the students' individual needs. This complexity, coupled with a general lack of teacher familiarity with games and game culture, is likely a reason for the relatively low use of board games in formal instructional settings such as schools. Artificial Intelligence (AI) has long been used in education, but the recent diffusion of user-friendly tools for large language models (LLM) opens a new range of possibilities to assist teachers and educators in instructional design: This includes the design and implementation of bGBL. In a preliminary study, we explored the ability of a well-known chatbot, ChatGPT, to select board games and suggest modifications to better align with the classroom context and personal student needs. However, this study was limited to a sample learning unit and was based on a posteriori evaluation by experts. In this contribution, we develop a new testing protocol to assess the reliability, effectiveness, and context sensitivity of several LLMs to adapt given board games to different classroom scenarios. The methodology features blind comparison of AI and human experts. The results suggest that general-purpose AI tools such as Copilot, Claude, and ChatGPT can provide quality and context-sensitive board game modification suggestions, to the point of slightly overperforming human experts in aligning personalisation suggestions to instructional goals. This study represents a first foray in the use of general Artificial Intelligence to assist the modding, or personalisation, of board game-based learning activities and, despite its limitations as a pilot experiment, might pave the way for successful integration of assistive technologies in game-based learning and facilitating its integration in the school curriculum.

Keywords: Artificial Intelligence, Instructional Design, Board Games, Personalisation, Modding.

1. Introduction

1.1 Board Game-Based Learning

(bGBL) is an educational methodology that exploits board, or tabletop, game mechanisms (Engelstein and Shalev, 2019) to provide students with an engaging, motivating, and social learning environment (Bayeck, 2020). Board games have long been used as a learning tool in human societies (Parlett, 1999; Donovan, 2017), but they also meet the needs of new generations of learners due to their specific properties. First, they promote collaboration and healthy competition among students. Collaboration favours the exchange of knowledge, negotiation of solutions, and the development of communication and teamwork skills (Berland and Lee, 2011). At the same time, healthy competition can motivate students to do their best, encouraging the pursuit of excellence and the development of problem solving skills in a challenging and fun context (Plass *et al.*, 2013). Second, playing around a table generates a sense of sharing a common experience, or "togetherness" (Calleja, 2022), which is a catalyst of spontaneous engagement towards the activities, allowing a positive disposition towards self-expression and risk-taking (DeKoven, 1978; Suits, 2014). Third, board games are "transparent systems" as their rules and the way they interact in gameplay are visible and enacted by players. This allows them to explore nonlinear systems in ways no other media allows (Berland and Duncan, 2016; Zeijlemaker *et al.*, 2022). Fourth, board games can be easily modified, or personalised, to align with learning goals and standards, promote inclusion, and achieve different educational and instructional goals (Castronova and Knowles, 2015; Sardone and Devlin-Scherer, 2016; Abbott, 2019; Sousa, 2021; Sardone, 2022).

1.2 In-game and Around-game Personalisation

To achieve effective alignment between learning goals and game goals (de Freitas and Oliver, 2006), teachers and educators must not only select a game that suits their educational and ludic needs, but must also be able to modify, or personalise, them, according to the specific educational context. The customisation (or personalisation) of the game experience is a key steps in bGBL (Abbott, 2019; Sousa, 2021; Sardone, 2022; Andreoletti and Tinterri, 2023); first, it is unlikely to find games that perfectly fit the learning goals of the activity (Van and Freitas, 2011; Arnab *et al.*, 2015); second, the specificities of the learning context often require specific measures to promote inclusion to allow participation of all students (Davis-Temple, Jung and Sainato, 2014; Heron *et al.*, 2018; Westwood, 2018). Targeted approaches and effective strategies are essential to ensure an optimal learning experience (Nicholson, 2011; Denham, 2016; Weitze, 2016; Sousa, 2023). Customising existing games makes the best use of already available resources by making targeted modifications to suit games to the specific needs of students. The possibilities for customisation are numerous and include modifying game parameters, such as adjusting the difficulty or varying the modes of interaction; adding instructional elements, such as quiz questions or informational resources; and integrating specific educational content, such as instructional materials related to the topics covered. Based on the work of Ejsing-Duun and Hanghøj (2019), the authors defined two main strategies for game personalisation (Andreoletti and Tinterri, 2023):

- In-game: changes that modify game mechanics; examples include modifying game components to better align with subject matter (Sardone, 2022), changing game objectives (Castronova and Knowles, 2015), etc.
- Around game: changes to the game experience that does not require modifying the physical components or the mechanisms of the game; examples include playing in couples, introducing moments for self-reflection (Abbott, 2019), etc.

According to the desired goals and the teacher's familiarity with game design principles, in-game and around-game personalisation provide non-exclusive opportunities to customise games to achieve better constructive alignment (Biggs, 1996; Andreoletti and Tinterri, 2023). However, modifying the game experience can be a daunting task for teachers, who generally possess little knowledge of games and game design principles and have trouble in exploiting the educational potential of games beside its motivational value or as an exercise tool (Allsop and Jessel, 2015; Loperfido, Dipace and Scarinci, 2019; Persico *et al.*, 2019).

1.3 General Artificial Intelligence in Board-game Based Learning

Artificial Intelligence (AI) has the potential to revolutionise education (Adiguzel, Kaya and Cansu, 2023; Baidoo-Anu and Owusu Ansah, 2023) by enhancing the quality of teaching and learning practices, promoting personalised learning, automating routine tasks and allowing smart management of classes and resources. AI-assisted education is not a new concept, as machine learning has been used for years to assist educational tasks (Southgate *et al.*, 2019); however, the recent mass availability of AI models based on large-language models (LLMs), or "general" AI, represented a turning point: The user-friendly conversational interface of tools such as OpenAI ChatGPT, Anthropic Claude, Microsoft Copilot, and others, allowed non-AI experts to explore the potential of AI In assisting a growing range of instructional practices (Ch'ng, 2023). While these tools present significant ethical (Yan *et al.*, 2023) and literacy (Ng *et al.*, 2021) challenges, they could represent an invaluable tool to assist the design of bGBL, helping teachers bridge gaps in game knowledge and design by providing suggestions for game choice and personalisation. In a previous pilot study, we explored the potential of general Artificial Intelligence (AI) tools to assist teachers in the choice and personalisation of board games for learning (Tinterri *et al.*, 2024); in a follow-up study, we extensively assessed the reliability, accuracy and context-sensitivity of ChatGPT in choosing board games for specific learning contexts and observed that, while the model is not entirely reliable, its choices are generally in line with those of human experts and sensible to the educational context (Tinterri *et al.*, in press). In this study, we explore whether different AI tools can provide personalisation suggestions, both in-game and around-game, that are of sufficient quality to be realistically integrated in bGBL practice. Thus, the research questions of this study are:

RQ1: Are there any differences in performance for the different AI tools examined?

RQ2: Are general AI models able to provide helpful (i.e. comparable to human experts) suggestions for the personalisation of board games for learning?

2. Methods

The experiment has been carried out in four steps: first, we defined the pedagogical and instructional bGBL framework to construct the tasks for AI and human evaluators. Second, we built instructions for evaluators and the prompts for AI models. The third phase was divided in two subphases: first, we collected the suggestions for game personalisation from AI models and human experts; subsequently, we asked human evaluators to blind rate the personalisation suggestions from their peers and AI. In the fourth phase, we collected and analysed the data.

2.1 Instructional Framework and Experimental Protocol

Designing meaningful and impactful bGBL experiences requires the intentional alignment of various critical components. These components include disciplines, dimensions of competence, the infusion of engaging and immersive playful scenarios, and the careful selection of pedagogical approaches (Biggs, 1996; Nicholson, 2011; Torrente *et al.*, 2011; Catalano, Luccini and Mortara, 2014; Sardone and Devlin-Scherer, 2016; Weitze, 2016; Salen, 2017; Parrish, 2020; Erdoğan, Atasay Sunay and Eryılmaz Çevirgen, 2022; Andreoletti and Tinterri, 2023; Cantoia, Clegg and Tinterri, 2023; Sousa, 2023). This alignment is the keystone upon which the effectiveness of educational interventions is built (Lyon, 2016). For this study, we used the GDBL ID model (Andreoletti and Tinterri, 2023; Tinterri *et al.*, *in press*) for bGBL design, based on the well-known ADDIE instructional model.

The educational framework for the two sample activities that were provided to AI and human experts included:

1. A description of the level of instruction (primary or secondary school) and classroom context, including demographic information, general assessment of the cognitive, motivational, and socioemotional characteristics of the students, and indications of the presence of students with special learning needs.
2. The learning objectives of the activity, structured in a learning goal and observable evidence.
3. The game scenario. Hanghøj (2013) uses this term to refer to the "dynamic, future-oriented models for possible actions" (*ibid*., p.2) that are embedded in gameplay. Game scenarios "can be used to explore and experiment with the construction, deconstruction, and reconstruction of knowledge" (*ibid*., pp.2-3). Scenarios for the activity has been based on the mapping of 15 game scenarios by (Andreoletti and Tinterri, 2023; Tinterri and Andreoletti, *in press*), which expanded on the work of Salen and colleagues (2010).
4. The game goals of the activity. They define the learning processes that activate spontaneously through and during gameplay and are made visible by the actions of the players. Game goals for the activity have been selected based upon a preliminary categorisation made by the authors for each game scenario (Tinterri *et al.*, submitted).
5. The games selected for the activity. An advanced research had been performed on *BoardGameGeek* (www.boardgamegeek.com), indicating as parameters: 1) publication between 2000 and 2024, as recent games usually present more streamlined rules and more accessible components; 2) user rating between 5 and 10 with a minimum of 20 ratings, to exclude prototypes, unpublished or self-published games; 3) complexity rating between 0 and 2.5, to exclude excessively complex games; 4) indicating as categories: Educational+Math for the first activity, Medieval+Civilisation for the second. The query resulted in 26 titles for the first search and 5 for the second. Putative titles have been individually parsed by the researchers to identify games that fit the learning objective and game goals according to five criteria: accessibility, setting, content, learning curve, and opportunities for assessment (Tinterri *et al.*, in press) . The resulting activities are described in Table 1.

Table 1: Characteristics of the Learning Activities used for personalisation suggestions.

	Activity 1	Activity 2
Target	Primary School	Secondary School
Classroom context (summary)	20 students (11 boys and 9 girls), lively, dynamic, and inclusive; cultural and linguistic diversity.	22 students (11 boys and 11 girls), a welcoming and challenging environment. Special educational needs: Marco (motor disability, 12 hours of support weekly), Sofia (learning difficulties, 10 hours of support weekly), and Alessio (autism spectrum disorder, 15 hours of support weekly).
Learning	Develop competencies in basic calculus.	Understand and analyse historical events.

	Activity 1	Activity 2
goals		
Acceptable evidence	[The student]: correctly executes additions and subtractions up to 100; uses such operations to solve simple problems; uses concrete materials, such as cubes, or counters, to aid calculations.	[The student]: identifies and describes the main events and historical periods of Middle Age; analyses causes and consequences of historical events, connecting past, present, and future. uses primary and secondary sources to interpret historical events of the Middle Age.
Game scenario	Exercise	Documentation
Game goals	1c. Interpret and respond to sensory stimuli present in the game (visual, auditory, and/or tactile). 16e. Choose paths and levels of challenge according to one's own skills and abilities. 16f. Self-assess the understanding of specific concepts through quizzes or activities in the game. 24g. Incrementally integrate new concepts during the game.	10d. Celebrate personal success and achievement obtained during gameplay. 16h. Use the components of the game, such as cards, tiles, or characters, to create unique and personal scenarios.
Game	Secret Code 13+4.	Era: The Medieval Age

2.2 Prompt Building and Execution

The instructions summarised in Table 2 were provided to human experts and four general AI models: OpenAI ChatGPT, in both GPT-4 and GPT-4o versions, Microsoft Copilot, and Anthropic Claude. Prompts were built according to the principles described in (Tinterri *et al.*, 2024). Shortly, a series of successive prompts were given to instruct the AI. Instruction specified the persona ("You are an instructional designer of learning activities that use board games. Your task is to propose personalisation (modding) opportunities for the game activity according to the context and the goals that will be given to you [...]"). Further prompts described a) the task, including criteria for game personalisation evaluation and definition of key terms b) examples of in-game and around-game personalisation c) the classroom context d) the learning goals of the activity e) the scenario and game goals f) the rules of the game, uploaded as pdf in models that allow this function (ChatGPT and Claude) and summarised as text input in Copilot. Afterwards, the script was run in the four AI tools examined and results were collected using Google Sheets.

2.3 Expert Evaluation

The three experts recruited for the study have specific experience in bGBL and work as educators or teachers in primary or secondary school. They were given the same instruction as AI models and asked to propose an in-game and an around-game personalisation for each activity. Their suggestions were collected via Google Sheets. ChatGPT was used to rewrite all personalisation suggestions (both AI- expert-generated) to prevent identification of AI-proposed suggestions by means of stylistic cues. Then, suggestions were randomised, and each expert rated each personalisation suggestion (except their own) on a scale of 1 to 5 based on three factors: constructive alignment (how much the suggestion reduced the distance between learning goals and the game internal goals), feasibility (how easily the modification could be implemented) and inclusivity (how much the suggestion facilitates access to learning, according to individual characteristics) and were asked to provide a short motivation for their ratings.

2.4 Data Analysis

Data was analysed using Jamovi software (Şahin and Aybek, 2020). Statistical testing used nonparametric analysis (Mann-Whitney U test and Kruskal-Wallis test).

3. Results

For each activity, we obtained 14 personalisation suggestions: 6 from human experts (3 in-game and 3 around-game) and 8 from AI software (4 in-game and 4 around-game). Human-generated suggestions were averaged based on the two rankings received by the other two experts and AI-generated suggestions based on all three experts' scores. Table 2 shows an example of the rankings obtained for in-game personalisation in Activity 1.

Table 2: Short description and median ranking for in-game personalisation for Activity 1.

Author	Content (synthesis)	Alignment	Feasibility	Inclusion	Total
Claude	Instead of target numbers, the "barrier" tokens represent additions, subtractions, or multiplications to be solved using the available dice.	5	4	4	13
ChatGPT (GPT-4)	Introduce "challenge cards" that require more complex mathematical operations and increase rewards.	4	4	4	12
Expert 3	The choice of mathematical operations which can be used for each barrier is restricted (only sum-subtraction or multiplication-division).	4	4	4	12
ChatGPT (GPT-4o)	Cooperative instead of competitive gameplay.	4	4	4	12
Copilot	Add a special dice with +, -, × and ÷ symbols. If the result matches the required operation, it can be spent instead of using numbered dice.	4	5	2	11
Expert 1	Extra points for using more difficult operations.	3,5	4,5	2	10
Expert 2	Increase numbers up to 100, with a d10 for units and a d10 for tens.	3	3,5	2	8.5

3.1 Comparison of AI Tools Personalisation Suggestions

We first checked whether human experts could distinguish AI suggestions from those of their human peers, by asking them to indicate, for each suggestion, if they thought it came from humans or AI. Overall, the expert evaluators, all of whom have previous experience with general AI tools, did a poor job of identifying personalisation suggestions as human or machine generated (38%, 45%, and 38% success rate, respectively). This indicates that the results observed were likely not biased by conscious or subconscious preconceptions towards AI. We also checked that the scores of personalisation's proposed by human experts do not significantly differ between them, also considering the different contexts (primary and secondary) and in-game and around-game personalisation (Mann-Whitney U, data not shown). This confirms that the experts have comparable bGBL skills and experience. To answer RQ1, we compared performance by the different AI tools that have been used in the study. We did not observe any significant difference (Kruskal-Wallis, 3df, X^2=1.69, p=0.64) when comparing the overall rankings achieved by the suggestions by different AI tools (Table 3); the same is true when considering only individual dimensions (Constructive alignment, Feasibility, and Inclusion; data not shown).

Table 3: Average aggregate score of personalisation suggestion by the AI tools examined in the study. Personalisation concerning Activity 1 and 2 and in-game and around-game modalities are pooled together in the analysis.

Software	N	Mean	Median	St. Dev	Min value	Max Value
ChatGPT (GPT-4)	4	11.00	11.50	7.54	9.00	12.00
ChatGPT (GPT-4o)	4	12.15	12.00	8.20	11.00	12.00
Claude	4	11.50	11.50	5.51	10.00	13.00
Copilot	4	11.00	11.00	13.36	10.00	12.00

3.2 Comparison of AI-generated and Human-generated Personalisation Suggestions

To answer RQ2 and compare the quality of AI-generated and human-generated suggestions, we pooled personalisation suggestions for the two activities and compared the performance of AI and humans. Nonparametric Mann-Whitney U test shows that the overall median score achieved by AI tools for in-game personalisation does not differ significantly from median score of human-suggested personalisation (Table 4). Conversely, AI-generated suggestions received significantly better scores than human-generated ones for constructive alignment in in-game personalisation. The scores achieved by AI and human experts are similar also for around-game personalisation, , suggesting that AI tools can provide game personalisation's of comparable quality to that of human experts.

Table 4: Comparison of median rankings for in-game and around-game personalisation suggested by human experts (experts) and AI tools (AI). Table compares aggregated scores for the three dimensions evaluated by experts (constructive alignment, feasibility, and inclusion) as well as the overall score obtained by their sum.

	Group	N	In-game				Around-game			
			Mean	Median	SD	M-W U (p-value)	Mean	Median	SD	M-W U (p-value)
Constructive Alignment	Experts	6	3.42	3.50	0.376	2.50 (0.004*)	3.25	3.50	0.689	16.0 (0.305)
	AI	8	4.38	4.00	0.518		3.63	4.00	0.518	
Feasibility	Experts	6	3.83	3.75	0.606	24 (1.00)	4.17	4.50	0.876	20.0 (0.626)
	AI	8	3.75	4.00	0.886		4.25	4.00	0.463	
Inclusion	Experts	6	2.83	2.75	0.816	21.50 (0.778)	3.50	3.50	0.447	20.0 (0.620)
	AI	8	3.00	3.00	0.926		3.63	4.00	0.518	
Overall	Experts	6	10.08	9.75	1.393	13.00 (0.168)	10.92	11.00	1.281	18.0 (0.449)
	AI	8	11.13	11.50	1.356		11.50	11.50	0.535	

4. Discussion

In this exploratory study, we tested the ability of different general AI tools to provide personalisation suggestions for board game-based learning (bGBL) activities. The methodology of choice used a two-step protocol that saw AI tools and human experts provide personalisation suggestions for specific bGBL activities in parallel, followed by blind evaluation of the suggestions by the same experts. In this way, we were able to avoid scoring bias. We observed that the AI tools included in the study were similarly effective in providing quality and context-sensitive personalisation suggestions, achieving similar scores to those of human experts or slightly overperforming them in specific categories (Table 4). This preliminary finding suggests that, when provided clear and comprehensive instruction, current state-of-the-art general AI models can be a useful tool to assist the complex task of personalising games for bGBL instructional design, as they are able to provide personalisation suggestions in line with those of human experts for alignment with subject matter, feasibility, and inclusivity. Furthermore, this seems to be true for different school contexts as well as for modifications that involve changes to game mechanisms (in-game personalisation) as well as those that do not, suggesting that these tools can fine-tune their suggestions according to the needs of the teacher/designer. However, this experimental study has a few limitations. The first is numerosity: the study only involved three human experts and a total of 28 personalisation suggestions from two sample activities. While the collected data is enough to identify significant tendencies, the involvement of more experts would ensure that an expert's personal preference or inclinations would have a marginal influence on results, and the use of more contextual scenarios and games would help generalise the results obtained. Second, there is considerable evidence in AI literature that the quality of prompts plays a key role in the quality of answers from AI tools (Bozkurt and Sharma, 2023; Liu, 2023). The prompts used in this study use currently known best practices, such as providing a persona, clear progressive instructions, and limiting word count; still, research on prompting techniques is still in its infancy, and different prompting strategies have not been addressed in this study. Third, European policies towards ethical use of AI in education stress the importance of explainability and transparency in AI models (European Parliament, 2024); however, the tools used in this study, such as ChatGPT, work as "black boxes", meaning that it is impossible to know what information has been used to compute answers and how they have been obtained. This is a significant limitation that suggests the adoption of different, less controversial tools in the future. Fourth, bGBL currently lacks established, evidence-supported pedagogical and instructional frameworks. In building the experimental framework for this study, we used the GDBL ID model developed by the authors, which is based on state-of-the art literature and currently being empirically tested. Still, this being a work in progress, it would be beneficial to compare the results obtained with different bGBL models.

5. Conclusion

Taken together, this study represents a first foray in the use of general Artificial Intelligence to assist the modding, or personalisation, of board game-based learning activities. Despite the limitations due to its pilot nature, this work indicates that common AI tools can help personalisation of games by providing quality suggestions to modify board games gameplay to promote personalisation of learning and constructive alignment. This represents a potential breakthrough for the field of game-based learning, wherein mounting evidence concerning the effectiveness of games as a powerful learning environment is contrasted by limited adoption by teachers and educators, in no small part due to lack of game knowledge and game design skills. By providing context-sensitive and accurate suggestions for game personalisation, AI tools can help teachers in experimenting with bGBL and thus highlight the unique and largely unexplored educational potential of boardgames.

Author Contributions

Conceptualisation, A.T.; introduction and theoretical framework, A.T. and F.Pe..; methodology, A.T.; data acquisition, A.T.; data analysis, A.T., game evaluation G.V., F.Pa. and F.Pe; writing—original draft preparation, A.T. and M. di P..; writing—review and editing, A.T., M. di P., F.Pa., F.Pe., G.V.; supervision, A.T. All authors have read and agreed to the published version of the manuscript.

References

Abbott, D. (2019) 'Modding Tabletop Games for Education', in M. Gentile, M. Allegra, and H. Söbke (eds) *Games and Learning Alliance*. Cham: Springer International Publishing (Lecture Notes in Computer Science), pp. 318–329.

Adiguzel, T., Kaya, H. and Cansu, F. (2023) 'Revolutionizing education with AI: Exploring the transformative potential of ChatGPT', *Contemporary Educational Technology*, 15, p. ep429.

Allsop, Y. and Jessel, J. (2015) 'Teachers' Experience and Reflections on Game-Based Learning in the Primary Classroom: Views from England and Italy', *International Journal of Game-Based Learning*, 5(1), pp. 1–17.

Andreoletti, M. and Tinterri, A. (2023) *Apprendere con i giochi. Esperienze di progettazione ludica*. Roma: Carocci Editore (Tascabili Faber, 279).

Arnab, S. *et al.* (2015) 'Mapping learning and game mechanics for serious games analysis', *British Journal of Educational Technology*, 46(2), pp. 391–411.

Baidoo-Anu, D. and Owusu Ansah, L. (2023) 'Education in the Era of Generative Artificial Intelligence (AI): Understanding the Potential Benefits of ChatGPT in Promoting Teaching and Learning'. Rochester, NY.

Bayeck, R.Y. (2020) 'Examining Board Gameplay and Learning: A Multidisciplinary Review of Recent Research'.

Berland, M. and Duncan, S. (2016) 'Computational Thinking in the Wild: Uncovering Complex Collaborative Thinking through Gameplay', *Educational Technology*, 56(3), pp. 29–35.

Berland, M. and Lee, V.R. (2011) 'Collaborative Strategic Board Games as a Site for Distributed Computational Thinking':, *International Journal of Game-Based Learning*, 1(2), pp. 65–81.

Biggs, J. (1996) 'Enhancing teaching through constructive alignment', *Higher Education*, 32(3), pp. 347–364.

Bozkurt, A. and Sharma, R.C. (2023) 'Generative AI and Prompt Engineering: The Art of Whispering to Let the Genie Out of the Algorithmic World', *Asian Journal of Distance Education*, 18(2), pp. i–vii.

Calleja, G. (2022) *Unboxed: Board Game Experience and Design*. MIT Press.

Cantoia, M., Clegg, A. and Tinterri, A. (2023) 'Training Teachers to Design Game-Based Learning Activities: Evidence from a Pilot Project', *Computers in the Schools*, pp. 1–23.

Castronova, E. and Knowles, I. (2015) 'A Model of Climate Policy Using Board Game Mechanics', *International Journal of Serious Games*, 2.
Catalano, C.E., Luccini, A.M. and Mortara, M. (2014) 'Guidelines for an effective design of serious games', *International Journal of Serious Games*, 1(1).
Ch'ng, L.K. (2023) 'How AI Makes its Mark on Instructional Design'.
Davis-Temple, J., Jung, S. and Sainato, D.M. (2014) 'Teaching Young Children with Special Needs and Their Peers to Play Board Games: Effects of a Least to Most Prompting Procedure to Increase Independent Performance', *Behavior Analysis in Practice*, 7(1), pp. 21–30.
DeKoven, B. (1978) *The well-played game: a player's philosophy*. Cambridge, Massachusetts: MIT Press.
Denham, A.R. (2016) 'Improving the Design of a Learning Game Through Intrinsic Integration and Playtesting', *Technology, Knowledge and Learning*, 21(2), pp. 175–194.
Donovan, T. (2017) *It's All a Game: The History of Board Games from Monopoly to Settlers of Catan*. Macmillan.
Ejsing-Duun, S. and Hanghøj, T. (2019) 'Design Thinking, Game Design, and School Subjects: What is the Connection?',
Engelstein, G. and Shalev, I. (2019) *Building Blocks of Tabletop Game Design: An Encyclopedia of Mechanisms*.
Erdoğan, A., Atasay Sunay, M. and Eryılmaz Çevirgen, A. (2022) 'How to Play Board Games? A Framework Proposal for Classroom Settings', *Board Game Studies Journal*, 16, pp. 101–122.
European Parliament (2024) *REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL laying down harmonised rules on artificial intelligence and amending Regulations (EC) No 300/2008, (EU) No 167/2013, (EU) No 168/2013, (EU) 2018/858, (EU) 2018/1139 and (EU) 2019/2144 and Directives 2014/90/EU, (EU) 2016/797 and (EU) 2020/1828 (Artificial Intelligence Act)*.
de Freitas, S. and Oliver, M. (2006) 'How can exploratory learning with games and simulations within the curriculum be most effectively evaluated?', *Computers & Education*, 46(3), pp. 249–264.
Greenhalgh, S.P., Koehler, M.J. and Boltz, L.O. (2019) 'The Fun of Its Parts: Design and Player Reception of Educational Board Games', *Contemporary Issues in Technology and Teacher Education*, 19(3), pp. 469–97.
Hanghøj, T. (2013) 'Game-Based Teaching: Practices, Roles, and Pedagogies', *New Pedagogical Approaches in Game Enhanced Learning: Curriculum Integration*, pp. 81–101.
Heron, M.J. *et al.* (2018) 'Meeple Centred Design: A Heuristic Toolkit for Evaluating the Accessibility of Tabletop Games', *The Computer Games Journal*, 7(2), pp. 97–114. Available at: https://doi.org/10.1007/s40869-018-0057-8.
Liu, L. (2023) 'Analyzing the Text Contents Produced by ChatGPT: Prompts, Feature-Components in Responses, and a Predictive Model', *Journal of Educational Technology Development and Exchange (JETDE)*, 16(1), pp. 49–70.
Loperfido, F.F., Dipace, A. and Scarinci, A. (2019) 'TO PLAY OR NOT TO PLAY? A CASE STUDY OF TEACHERS' CONFIDENCE AND PERCEPTION WITH REGARD TO DIGITAL GAMES AT SCHOOL', *Italian Journal of Educational Technology*, 27(2), pp. 121–138.
Lyon, P. (2016) *Design Education: Learning, Teaching and Researching Through Design*. London: Routledge.
Ng, D.T.K. *et al.* (2021) 'Conceptualizing AI literacy: An exploratory review', *Computers and Education: Artificial Intelligence*, 2, p. 100041.
Nicholson, S. (2011) 'Making gameplay matter: designing modern educational tabletop games', *Knowledge Quest*, 40(1), pp. 60–66.
Parlett, D. (1999) *The Oxford History of Board Games*. Oxford University Press.
Parrish, P. (2020) 'Pedagogical Models for Compelling Learning Experiences with Technology', *EDEN Conference Proceedings*, pp. 247–256.
Persico, D. *et al.* (2019) 'Meeting players where they are: Digital games and learning ecologies', *British Journal of Educational Technology*, 50.
Plass, J.L. *et al.* (2013) 'The impact of individual, competitive, and collaborative mathematics game play on learning, performance, and motivation.', *Journal of Educational Psychology*, 105(4), pp. 1050–1066.
Şahin, M. and Aybek, E. (2020) 'Jamovi: An Easy to Use Statistical Software for the Social Scientists', *International Journal of Assessment Tools in Education*, 6(4), pp. 670–692.
Salen, K. *et al.* (2010) *Quest to Learn: Developing the School for Digital Kids*. MIT Press.
Salen, K. (2017) 'Designing a Place Called School: A Case Study of the Public School Quest to Learn', *She Ji: The Journal of Design, Economics, and Innovation*, 3(1), pp. 51–64.
Sardone, N.B. (2022) 'Modifying Board Games in Alignment with State Standards to Develop the Geographic Literacy of Elementary Level Learners', *The Social Studies*, 0(0), pp. 1–11.
Sardone, N.B. and Devlin-Scherer, R. (2016) 'Let the (Board) Games Begin: Creative Ways to Enhance Teaching and Learning', *The Clearing House: A Journal of Educational Strategies, Issues and Ideas*, 89(6), pp. 215–222.
Sousa, M. (2021) 'Serious board games: modding existing games for collaborative ideation processes', *International Journal of Serious Games*, 8(2), pp. 129–146.
Sousa, M. (2023) 'Mastering Modern Board Game Design to Build New Learning Experiences: the MBGTOTEACH Framework':, *The International Journal of Games and Social Impact*, 1(1), pp. 68–93.
Southgate, E. *et al.* (2019) *Artificial intelligence and emerging technologies in schools: Research report*. Newcastle, NSW: University of Newcastle.
Suits, B. (2014) *The Grasshopper - Third Edition: Games, Life and Utopia*. Broadview Press.

Tinterri, A. *et al.* (2024) 'AI in board Game-Based Learning', in *Proceedings of the First International Workshop on High-performance Artificial Intelligence Systems in Education*. *AIxEDU 2023 High-performance Artificial Intelligence Systems in Education*, CEUR-ws (CEUR Workshop Proceedings).
Tinterri, A. *et al.* (in press) 'Automating board-game based learning. A comprehensive study to assess reliability and accuracy of AI in game evaluation.', *Intelligenza Artificiale* [Preprint].
Tinterri, A. *et al.* (submitted) 'Towards a universal framework for Game-Based Learning: a model to align game goals and learning objectives', *Nuova Secondaria*.
Tinterri, A. and Andreoletti, M. (in press) 'A mapping of instructional scenarios for game-based learning', in *Proceedings Book of ISYDE2023*. *ISYDE 2023*.
Torrente, J. *et al.* (2011) *Production of Creative Game-Based Learning Scenarios*.
Van, J.-P. and Freitas, S. (2011) 'A Game-Based Learning Framework: Linking Game Design and Learning Outcomes', *Learning to Play: Exploring the Future of Education with Video Games*, 53.
Weitze, C.L. (2016) 'Designing for Learning and Play - The Smiley Model as Framework', *ID&A Interaction design & architecture(s)*, (29), pp. 52–75.
Westwood, P. (2018) *Inclusive and Adaptive Teaching: Meeting the Challenge of Diversity in the Classroom*. 2nd edn. London: Routledge.
Yan, L. *et al.* (2023) 'Practical and ethical challenges of large language models in education: A systematic scoping review', *British Journal of Educational Technology* [Preprint].
Zeijlemaker, S. *et al.* (2022) 'Decision-Makers' Understanding of Cyber-Security's Systemic and Dynamic Complexity: Insights from a Board Game for Bank Managers', *Systems*, 10(2), p. 49.