IBIMA Publishing
Communications of International Proceedings
https://ibimapublishing.com/p-articles/45AI/2025/4540925/
Vol. 2025 (20), Article ID 4540925

A Method for Generating Riddle-Driven Plots for Games*

Piotr CYBULSKI

Military University of Technology in Warsaw, Poland

Correspondence should be addressed to: Piotr CYBULSKI, piotr.cybulski@wat.edu.pl

* Presented at the 45th IBIMA International Conference, 25-26 June 2025, Cordoba, Spain

Abstract

Designing activities when the attention span of participants is short is not an easy task. One solution is to provide unique experience to participants. This article presents a method for generating a riddle-driven plot for games and other gamified activities. The proposed method allows to trace progress of a plot and checking if a generated plot is cognizable by a player. It is also possible to incorporate story volumes into a generation process. Formal definitions of structures used by the method are presented as well as an example of expressiveness of its components. The designed method makes checking cognizability of a plot feasible in polynomial time to the number of plot elements and relations between them.

Introduction

Gamification (also known as gameful design) is a method to increase motivation (Christopoulos and Mystakidis, 2023) which utilizes gaming elements in other context than full-fledged games (Deterding *et al.*, 2011) . One of such elements is a story. Games and gamification are successfully (Boyle *et al.*, 2016) incorporated in many areas aside from pure-entertainment one, starting from education (Gee, 2003; Khan *et al.*, 2017; Shen *et al.*, 2024; Wang *et al.*, 2022), to interpersonal skills, physical education(Culajara, 2022), entrepreneurship (Alghamdi, 2023; Parola *et al.*, 2024) and maintaining mental health (Lima *et al.*, 2022; Sailer *et al.*, 2017).

In this article a gaming element that we will be interested in is a story. We will use commonly adopted definition (Kybartas and Bidarra, 2017) of a story which says that a story consists of a plot and space. By plot we will conceive events that involve one or more elements from story's space. This paper will present a method for generating a plot, carried out as a riddle where we gather observations about the story.

Automatic generating a plot is not an easy task and as of now it requires cooperation between the author (designer) and a generating tool (Alhussain and Azmi, 2022; Kybartas and Bidarra, 2017) . The process itself is complicated due to multiple reasons. First and foremost, we want the plot to be embedded in particular world (space). In general, story's space is manually crafted and only the plot is (to some degree) generated (Kybartas and Bidarra, 2017) . Multiple storylines or plots may convey the same story from different perspectives (Karth *et al.*, 2022). Each such perspective must be consistent with the author's idea. In most cases it is undesirable for the plot to be fully understood or predicted based on initial interaction with it. We can compare it to puzzles, which may be put together using only some parts (Smith *et al.*, 2012) . On the other hand, we also don't want to generate a plot that can not be fully explored. An example of such a situation is when there is not enough clues to finish an investigation (Mohr *et al.*, n.d.). Moreover it is highly desirable for a plot to be credible by making its characters believable. This however requires considering different aspects of human psychology, such as characters believe

Cite this Article as: Piotr CYBULSKI, Vol. 2025 (20) "A Method for Generating Riddle-Driven Plots for Games " Communications of International Proceedings, Vol. 2025 (20), Article ID 4540925, https://doi.org/10.5171/2025.4540925

about the world they are and lies they may commit (Ware and Siler, 2021). All of this make plot generation task complex and time consuming (Mark Owen Riedl and R. Michael Young, 2004). The goal is to make each plot meaningfully different to others so they will be interesting for players while at the same time all of them will be restricted to author's properties. Achieving this goal may increase replayability and immersion (Guo and Lo, 2022; Rohan *et al.*, 2020) .

Current plot generation methods are based on various techniques such as epistemic logic (Mohr *et al.*, n.d.), machine learning (Fernandez-Samillan *et al.*, 2021; Yang *et al.*, 2025), planning algorithms (Mark Owen Riedl and R. Michael Young, 2004; Ware and Siler, 2021), even physics phenomena (Kim *et al.*, 2025). The methods described in this article aims to achieve multiple goals. First, it generates a plot which progress is easily tractable. Second, this method allows authors to incorporate story volumes (Grinblat, 2017) into generated plots. This means that each plot reveals only a part of the story, for example in the form of characters' history. This in turn results in a better understanding of a story after each playthrough.

Proposed Solution

The following method for generating plots has been inspired by Einstein's Riddle (also known as Zebra Puzzle) (Gregor *et al.*, 2015). In this riddle elements of six five-element sets are associated using one-to-one relation. A person who solves the riddle gets fragments of the story indicating the associations. The task is to answer the question in the form of: which element of a given set is associated with provided element.

Using the taxonomy proposed in (Kybartas and Bidarra, 2017), the method described in this paper belongs to a group of *generating constrained plot with manually authored space*. In turn, using the taxonomy presented in (Alhussain and Azmi, 2022), plot generating method from this paper is one of *planning-based models*.

The core of proposed method are domains, these are sets gathering distinguishable, yet somehow similar, elements. A domain may contain people, houses, numbers etc. There may be an arbitrary number of binary relations between any two domains. Each such binary relation will be defined within this framework as plot's information. An example of information between domains: (P)eople and (A)nimals may be a relation $\overset{own}{I_P^A}$. It associates a person to animals he or she owns. One of the differences between Einstein's Riddle and a plot constructed using this method is that elements may have no associations within information, as well as they can be associated with multiple elements in other domain. Figure 1 shows a graphical example of information in a plot. Information between two domains (even if it is the same domain) will be called simple information.

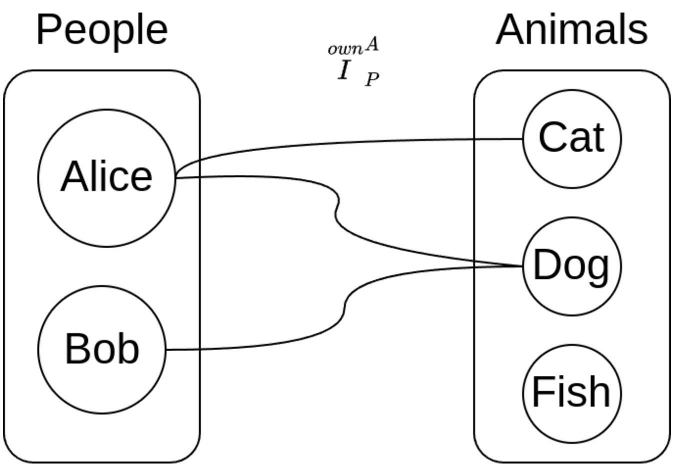

Figure 1: An example of information in a plot

Simple information can be composed to create complex information. For example, having three domains: people, animals and houses and two simple information: $\overset{own}{I_P^A}$ and $\overset{live}{I_H^P}$ we can compose then into a new information that can be interpreted as "what animals are in which house". Composition operation will be denoted as $\overset{\text{are in}}{I_H^A} = \overset{\text{live in}}{I_H^P} \circ \overset{\text{own}}{I_P^A}$. Figure 2 shows an example of complex information.

The first domain in both simple and complex information will be referred to as reference domain. Similarly, the last domain in information will be called compared domain.

In case plot (or riddle) is uncovered by a player, where associations between elements are unknown the domain being “uncovered” can be written as a matrix. In this form each row represents an element from reference domain and each column corresponds to an element in compared domain. These matrices consist of binary variables. If the value of such variable is equal to 1, it means that there is an association between elements. Similarly, if variable is equal to 0, then there is no association within this information between corresponding elements. Matrix form allows to easily trace progress of a plot by simply checking the value of desired variable. The same applies if we want to check whether plot is fully discoverable or not. An example of composition of information in matrix form is demonstrated in Table 1.

Table 1: A composition example of information in matrix form

$\overset{own}{I_P^A}$	Cat	Dog	Fish
Alice	x_{11}	x_{12}	x_{13}
Bob	x_{21}	x_{22}	x_{23}

Matrix 1: Information from Figure 1 as a riddle

$\overset{<}{I_A^A}$	Cat	Dog	Fish
Cat	0	1	0
Dog	0	0	0
Fish	1	1	0

Matrix 2: Information about which animals are smaller than which, in matrix form

$\overset{\text{own}}{I_P^A} \circ \overset{<}{I_A^A}$	Cat	Dog	Fish
Alice	x_{13}	$x_{11} + x_{13}$	0
Bob	x_{23}	$x_{21} + x_{23}$	0

Matrix 3: Composition of $\overset{own}{I_P^A}$ and $\overset{<}{I_A^A}$, the result is information which may be seen as „animals owned by P smaller than A”, where P is an element of People domain, and A is an element of Animals domain

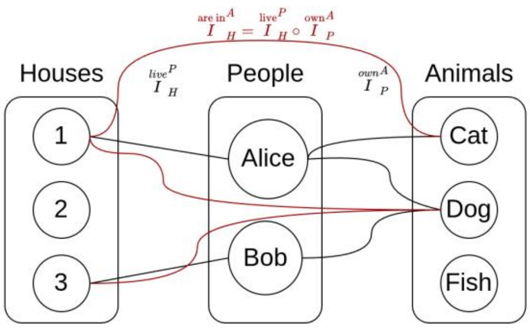

Figure 2: An example of complex plot information

Having a plot information, we can define a <u>metainformation</u>, that is information about information. A metainformation associates a set of associations to elements of some domain. An example of metainformation may be $\overset{count}{M}{}_P^N(\overset{own}{I}{}_P^A)$, which counts number of animals owned by a person. A graphical representation of a metainformation is depicted in Figure 3 . A part of this metainformation limited to Alice is shown in Matrix 4 .

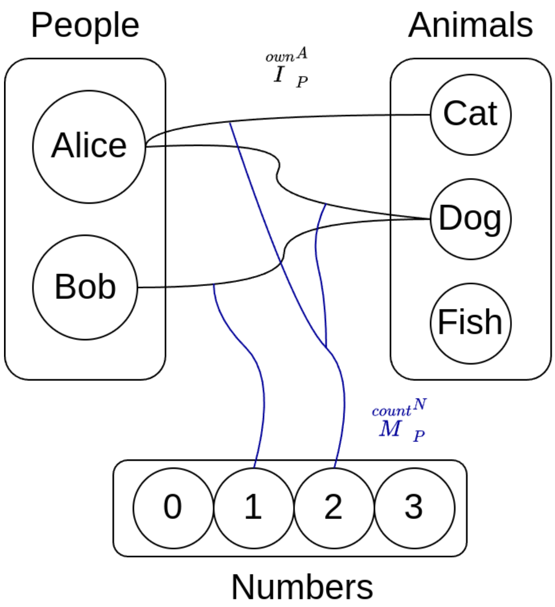

Figure 3: Example of metainformation

x_{11}	x_{12}	x_{13}	$M_P^N(I_P^A)$
0	0	0	0
0	0	1	1
0	1	1	2
0	1	0	1
1	1	0	2
1	1	1	3
1	0	1	2
1	0	0	1

Matrix 4: A part of metainformation as a matrix

Chain of associations starting from a given element from reference domain, and ending at compared domain, constructed using some information will be denoted as $I_Y^X(a)$. In this notation X and Y are compared and reference domains respectively, and $a \in Y$ is an element of reference domain. Such associations will be described as <u>observations</u>. An example of observations of information $\overset{own}{I}{}_P^A$ is $\overset{own}{I}{}_P^A(Alice) = \{Cat, Dog\}$, which may be seen as "Alice has a cat and a dog".

The last element required to create a plot is a <u>hint</u>, which is a pair of observations with an operator indicating how elements of compared domains are related to each other. Three such operators have been proposed to cover the following sentences in natural language:

- *„are the same"* – denoted as =
- *„have nothing in common"* – denoted as ≠
- *„are a subset of"* – denoted as ⊂

The $=$ operator is used when all elements in both compared domains are exactly the same. Operator $\neq$ means that no element in the compared domain occurs in more than one observation. The last operator $\subset$ is used if all elements in compared domain of observation on the left-hand side of the operator occur in the compared domain of the right-hand side of the operator. Additionally, the $\subset$ operator requires that the compared domain of the left-hand side observation was not empty.

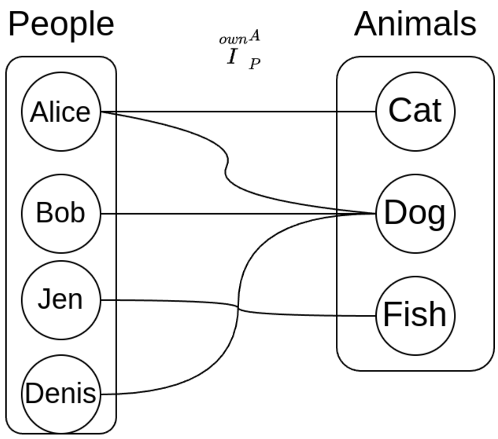

Figure 4: A plot information for operators usage example

$\overset{\text{own}}{I}{}^{A}_{P}$	Cat	Dog	Fish
Alice	x_{11}	x_{12}	x_{13}
Bob	x_{21}	x_{22}	x_{23}
Jen	x_{31}	x_{32}	x_{33}
Denis	x_{41}	x_{42}	x_{43}

Matrix 5: Plot information from Figure 4 as a matrix

Using the plot information from Figure 4, and variables from Matrix 5, below are listed example hints and corresponding logical expressions:

- Bob has the same animals as Denis:

"functional" notation — logical constraint

$$\overset{own}{I}{}^{A}_{P}(\text{Bob}) = \overset{own}{I}{}^{A}_{P}(\text{Denis}) \qquad \sim(x_{21} \otimes x_{41}) \wedge \sim(x_{22} \otimes x_{42}) \wedge \sim(x_{23} \otimes x_{43})$$

- Every animal owned by Denis is also in the possession of Alice:

"functional" notation — logical constraint

$$\overset{own}{I}{}^{A}_{P}(\text{Denis}) \subset \overset{own}{I}{}^{A}_{P}(\text{Alice}) \qquad \begin{array}{c} \sim(x_{21} \Rightarrow x_{11}) \wedge \sim(x_{22} \Rightarrow x_{12}) \wedge \sim(x_{23} \Rightarrow x_{13}) \\ x_{21} \vee x_{22} \vee x_{23} \end{array}$$

- Bob and Jen have no animals in common:

"functional" notation — logical constraint

$$\overset{own}{I}{}^{A}_{P}(\text{Bob}) \neq \overset{own}{I}{}^{A}_{P}(\text{Jen}) \qquad \sim(x_{21} \wedge x_{31}) \wedge \sim(x_{22} \wedge x_{32}) \wedge \sim(x_{33} \wedge x_{13})$$

A riddle-driven plot constructed using the above method consists of a set of logical constraints. These constraints can be transformed into an ILP problem (Brown and Dell, 2007). A plot is <u>fully cognizable</u> if all associations in every information are known. It means that the plot will be fully cognizable if the underlying ILP problem has exactly one solution. The number of solutions to the system of equations is equal to the number of lattice points in polyhedron defined with this equations (De Loera, 2005). Counting lattice points can be done in polynomial time with generating functions (Köppe, 2007). LattE (Baldoni *et al.*, 2013) software package allows to check if the plot is fully cognizable using exactly this approach. If one wants to check not only the cognizability of a plot but also which associations are yet uncertain the 4ti2 (4ti2 team, n.d.) software package is suitable to do so.

Example Plot

The following example aims to demonstrate the expressiveness of the proposed method, and not a fully-fledged plot.

The background of the plot is as follows: there are 3 balls in a box with numbers from 1 to 3 assigned to them. A boy and a girl could have taken any number of balls, including none. Each ball could have been taken regardless of other person choice.

The plot consists of three domains: people, and two domains with numbers. The first numbers domain contains numbers from 1 to 3, and the second from 0 to 6. Domain with people has two elements: boy and girl. There are five information types available in the plot:

- I_P^N - who has taken which balls, no association means no ball taken;
- $\overset{<}{I_N^N}$ - which element of domain Numbers is smaller than which one (a partial order);
- $\overset{min}{M_P^N}(I_P^N)$ - a value of smallest ball taken out of the box;
- $\overset{sum}{M_P^S}(I_P^N)$ - a sum of values of balls taken out of the box;
- $\overset{count}{M_P^S}(I_P^N)$ - a number of balls taken out the box.

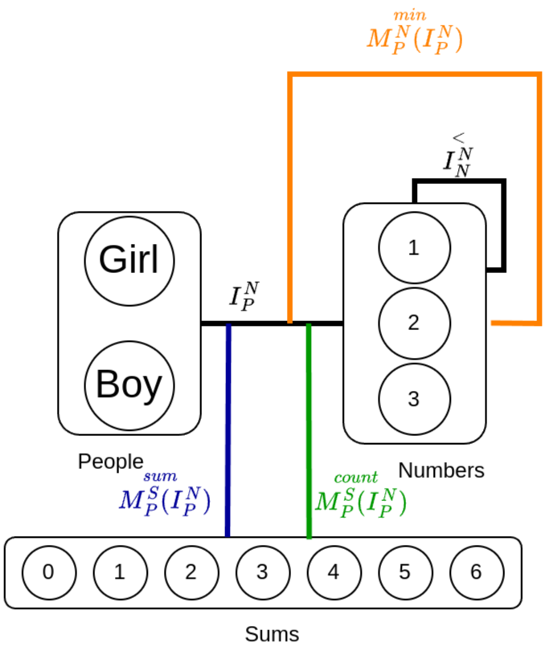

Figure 5: Overview of domains and information used in the example plot

The following are hint templates available to a player:

- $\overset{sum}{M_P^S}(I_P^N(x)) = \overset{sum}{M_P^S}(I_P^N(y))$ - the sum of balls taken by person x is equal to the sum of balls taken by person y;
- $\overset{sum}{M_P^S}(I_P^N(x)) \neq \overset{sum}{M_P^S}(I_P^N(y))$ - the sum of balls taken by person x is not the same as the sum of balls taken by person y;
- $\overset{count}{M_P^S}(I_P^N(x)) \neq \overset{count}{M_P^S}(I_P^N(y))$ - the number of balls taken by person x is not equal to the number of balls taken by person y;
- $\overset{count}{M_P^S}(I_P^N(x)) = \overset{count}{M_P^S}(I_P^N(y))$ - the number of balls taken by person x is equal to the number of balls taken by person y;
- $\overset{min}{M_P^N}(I_P^N(x)) \subset \overset{min}{M_P^N}(I_P^N(y)) \circ \overset{<}{I_N^N}$ - the smallest ball taken by x is smaller than the smallest ball taken by y.

Before gameplay or gamified activity begins, a plot is constructed behind the scenes. During a gameplay, player encounters some hints that are instantiated from the above templates. The plot is fully cognizable from the following hints:

- $\overset{sum}{M_P^S}(I_P^N(\text{Boy})) = \overset{sum}{M_P^S}(I_P^N(\text{Girl}))$ - the sum of balls taken by the boy is equal to the sum of balls taken by the girl;
- $\overset{count}{M_P^S}(I_P^N(\text{Boy})) \neq \overset{count}{M_P^S}(I_P^N(\text{Girl}))$ - the number of balls taken by the boy is not equal to the number of balls taken by the girl;
- $\overset{min}{M_P^N}(I_P^N(\text{Boy})) \subset \overset{min}{M_P^N}(I_P^N(\text{Girl})) \circ \overset{<}{I_N^N}$ - the smallest ball taken by the boy is smaller than the smallest ball taken by the girl.

Having the above hints, a player can fully infer all associations between elements within the plot.

Final Conclusions

This article presents a method for generating a riddle-driven plot that can be used in both games and gamified activities. It is designed for traceability of progress and allows to easily check if a generated plot is fully cognizable. Components of this method can be described using both graphical notation, as well as a set of matrices. The directions for future work include a method for validation if the manually crafted set of hint templates is sufficient to make plot cognizable. Additionally, the method can be extended to produce false hints. This way a generated plot could be used as a tool for learning how to deal with misinformation, which is so important nowadays. The last thing to consider is to extend this method so that not only plot is generated, but also elements of space.

References

- 4ti2 team. (n.d.). “4ti2 - A software package for algebraic, geometric and combinatorial problems on linear spaces”.
- Alghamdi, E. (2023), “DIGITAL GAMES USE IN ENTREPRENEURHIP EDUCATION AT THE UNDERGRADUATE LEVEL: A SYSTEMATIC REVIEW”, *Journal of Management and Business Education*, Vol. 6 No. 2, pp. 172–198, doi: 10.35564/jmbe.2023.0009.
- Alhussain, A.I. and Azmi, A.M. (2022), “Automatic Story Generation: A Survey of Approaches”, *ACM Computing Surveys*, Vol. 54 No. 5, pp. 1–38, doi: 10.1145/3453156.
- Baldoni, V., Berline, N., De Loera, J.A., Dutra, B., Koppe, M., Moreinis, S., Pinto, G., *et al.* (2013), “A User’s Guide for LattE integrale v1.7.2”.
- Boyle, E.A., Hainey, T., Connolly, T.M., Gray, G., Earp, J., Ott, M., Lim, T., *et al.* (2016), “An update to the systematic literature review of empirical evidence of the impacts and outcomes of computer games and serious games”, *Computers & Education*, Vol. 94, pp. 178–192, doi: 10.1016/j.compedu.2015.11.003.
- Brown, G.G. and Dell, R.F. (2007), “Formulating Integer Linear Programs: A Rogues’ Gallery”, *INFORMS Transactions on Education*, Institute for Operations Research and the Management Sciences (INFORMS), Vol. 7 No. 2, pp. 153–159, doi: 10.1287/ited.7.2.153.
- Christopoulos, A. and Mystakidis, S. (2023), “Gamification in Education”, *Encyclopedia*, Vol. 3 No. 4, pp. 1223–1243, doi: 10.3390/encyclopedia3040089.
- Culajara, C.J. (2022), “Integrating game-based approach in students learning experiences in physical education: A phenomenological study”, *Edu Sportivo: Indonesian Journal of Physical Education*, Vol. 3 No. 3, pp. 242–254, doi: 10.25299/es:ijope.2022.vol3(3).10520.
- De Loera, J.A. (2005), “The many aspects of counting lattice points in polytopes”, *Mathematische Semesterberichte*, Springer Science and Business Media LLC, Vol. 52 No. 2, pp. 175–195, doi: 10.1007/s00591-005-0094-9.
- Deterding, S., Dixon, D., Khaled, R. and Nacke, L. (2011), “From game design elements to gamefulness: defining ‘gamification’”, *Proceedings of the 15th International Academic MindTrek Conference: Envisioning Future Media Environments*, presented at the MindTrek ’11: Academic MindTrek 2011, ACM, Tampere Finland, pp. 9–15, doi: 10.1145/2181037.2181040.
- Fernandez-Samillan, D., Guizado-Diaz, C. and Ugarte, W. (2021), “Story Creation Algorithm Using Q-Learning in a 2D Action RPG Video Game”, *2021 28th Conference of Open Innovations Association*

(FRUCT), presented at the 2021 28th Conference of Open Innovations Association (FRUCT), IEEE, Moscow, Russia, pp. 111–117, doi: 10.23919/FRUCT50888.2021.9347596.

- Gee, J.P. (2003), “What video games have to teach us about learning and literacy”, *Computers in Entertainment*, Vol. 1 No. 1, pp. 20–20, doi: 10.1145/950566.950595.
- Gregor, M., Zabovska, K. and Smatanik, V. (2015), “The zebra puzzle and getting to know your tools”, *2015 IEEE 19th International Conference on Intelligent Engineering Systems (INES)*, presented at the 2015 IEEE 19th International Conference on Intelligent Engineering Systems (INES), IEEE, Bratislava, Slovakia, pp. 159–164, doi: 10.1109/INES.2015.7329698.
- Grinblat, J. (2017), “Emergent Narratives and Story Volumes”, in Short, T. and Adams, T. (Eds.), *Procedural Generation in Game Design*, 1st ed., A K Peters/CRC Press, Boca Raton : Taylor & Francis, CRC Press, 2017., pp. 199–207, doi: 10.1201/9781315156378-22.
- Guo, Z. and Lo, C.-H. (2022), “How Do Narrative Features Affect a Player’s Immersion in Computer Games? The Analytical Hierarchy Process Approach”, in Rau, P.-L.P. (Ed.), *Cross-Cultural Design. Applications in Learning, Arts, Cultural Heritage, Creative Industries, and Virtual Reality*, Vol. 13312, Springer International Publishing, Cham, pp. 468–483, doi: 10.1007/978-3-031-06047-2_35.
- Karth, I., Junius, N. and Kreminski, M. (2022), “Constructing a Catbox: Story Volume Poetics in Umineko no Naku Koro ni”, in Vosmeer, M. and Holloway-Attaway, L. (Eds.), *Interactive Storytelling*, Vol. 13762, Springer International Publishing, Cham, pp. 455–470, doi: 10.1007/978-3-031-22298-6_29.
- Khan, A., Ahmad, F.H. and Malik, M.M. (2017), “Use of digital game based learning and gamification in secondary school science: The effect on student engagement, learning and gender difference”, *Education and Information Technologies*, Vol. 22 No. 6, pp. 2767–2804, doi: 10.1007/s10639-017-9622-1.
- Kim, H., Seo, B. and Kang, S. (2025), “Puzzle-Level Generation With Simple-Tiled and Graph-Based Wave Function Collapse Algorithms”, *IEEE Transactions on Games*, Vol. 17 No. 1, pp. 52–61, doi: 10.1109/TG.2024.3368017.
- Köppe, M. (2007), “A Primal Barvinok Algorithm Based on Irrational Decompositions”, *SIAM Journal on Discrete Mathematics*, Vol. 21 No. 1, pp. 220–236, doi: 10.1137/060664768.
- Kybartas, B. and Bidarra, R. (2017), “A Survey on Story Generation Techniques for Authoring Computational Narratives”, *IEEE Transactions on Computational Intelligence and AI in Games*, Vol. 9 No. 3, pp. 239–253, doi: 10.1109/TCIAIG.2016.2546063.
- Lima, L., Pinto, C., Unterholzner, A. and Gouveia, P. (2022), “Digital Games and Mental Health: A Scoping Review on Gaming Disorder in the Last Decade”, in Marques, A. and Queirós, R. (Eds.), *Advances in Psychology, Mental Health, and Behavioral Studies*, IGI Global, pp. 142–162, doi: 10.4018/978-1-7998-8634-1.ch007.
- Mark Owen Riedl and R. Michael Young. (2004), “An Intent-Driven Planner for Multi-Agent Story Generation”, *AAMAS ’04*, Vol. 2, presented at the The Third International Joint Conference on Autonomous Agents and Multi-Agent Systems 2004, IEEE Computer Society, New York, pp. 186–193, doi: 10.1109/AAMAS.2004.63.
- Mohr, H., Eger, M. and Martens, C. (n.d.). “Eliminating the Impossible: A Procedurally Generated Murder Mystery”.
- Parola, A., Di Fuccio, R., Marcionetti, J. and Limone, P. (2024), “Digital games for career guidance: a systematic review using PRISMA guidelines”, *Behaviour & Information Technology*, Vol. 43 No. 3, pp. 475–485, doi: 10.1080/0144929X.2023.2177822.
- Rohan, R., Pal, D. and Funilkul, S. (2020), “Mapping Gaming Elements with Gamification Categories: Immersion, Achievement, and Social in a MOOC Setting”, *2020 14th International Conference on Innovations in Information Technology (IIT)*, presented at the 2020 14th International Conference on Innovations in Information Technology (IIT), IEEE, Al Ain, United Arab Emirates, pp. 63–68, doi: 10.1109/IIT50501.2020.9299047.
- Sailer, M., Hense, J.U., Mayr, S.K. and Mandl, H. (2017), “How gamification motivates: An experimental study of the effects of specific game design elements on psychological need satisfaction”, *Computers in Human Behavior*, Vol. 69, pp. 371–380, doi: 10.1016/j.chb.2016.12.033.
- Shen, Y., Jalil, H.A. and Jamaluddin, R. (2024), “A 10-Year Systematic Review on the Incorporation of Digital Games for Multimodal Literacy Education”, *WSEAS TRANSACTIONS ON COMPUTER RESEARCH*, Vol. 12, pp. 463–474, doi: 10.37394/232018.2024.12.46.
- Smith, A.M., Andersen, E., Mateas, M. and Popović, Z. (2012), “A case study of expressively constrainable level design automation tools for a puzzle game”, *Proceedings of the International Conference on the Foundations of Digital Games*, presented at the FDG’12: International Conference on the Foundations of Digital Games, ACM, Raleigh North Carolina, pp. 156–163, doi: 10.1145/2282338.2282370.

- Wang, L.-H., Chen, B., Hwang, G.-J., Guan, J.-Q. and Wang, Y.-Q. (2022), “Effects of digital game-based STEM education on students’ learning achievement: a meta-analysis”, *International Journal of STEM Education*, Vol. 9 No. 1, p. 26, doi: 10.1186/s40594-022-00344-0.
- Ware, S.G. and Siler, C. (2021), “Sabre: A Narrative Planner Supporting Intention and Deep Theory of Mind”, *Proceedings of the AAAI Conference on Artificial Intelligence and Interactive Digital Entertainment*, Vol. 17 No. 1, pp. 99–106, doi: 10.1609/aiide.v17i1.18896.
- Yang, D., Kleinman, E. and Harteveld, C. (2025), “GPT for Games: An Updated Scoping Review (2020-2024)”, *IEEE Transactions on Games*, pp. 1–16, doi: 10.1109/TG.2025.3563780.