Generating Tutorials for Personalized Learning Trajectories

Riemer van Rozen
rozen@cwi.nl
Centrum Wiskunde & Informatica
Amsterdam, The Netherlands

Abstract

Game-Based Learning (GBL) leverages games to teach subject matter in a fun and engaging manner. Puzzle games, in particular, are well-suited for creating interactive tutorials involving the discovery of a single dominant strategy. These tutorials present challenges (or goal chains) that offer players opportunities to learn through trial and error, as exemplified by PuzzleScript [4]. However, it is currently unknown how puzzle-based tutorials can be more broadly applied to create interactive tutorial environments for teaching STEM subjects such as coding [5], logic [2], or game design [6].

We investigate how to integrate puzzles and learning goals into tutorials that support personalized learning trajectories. We propose Procedural Tutorial Generation as a method and a field of study for integrating learning goals into puzzles, developing interactive environments around puzzles, and procedurally generating activities, interactions, and variations within those puzzles.

We present our progress and ongoing work, including: (1) a framework for didactics-driven development of educational games [1]; (2) tutorial analytics that predict how players can learn from failure [8]; (3) generating puzzle tutorials based on rewrite rules and verbs (Figs. 1 and 2) [7]; and (4) ¬SCR∧BL, an educational board game for teaching propositional logic (Fig. 3) [2, 3].

Keywords

Game-Based Learning, STEM Education, Puzzle Games, Procedural Tutorial Generation, Didactics-Driven Game Development

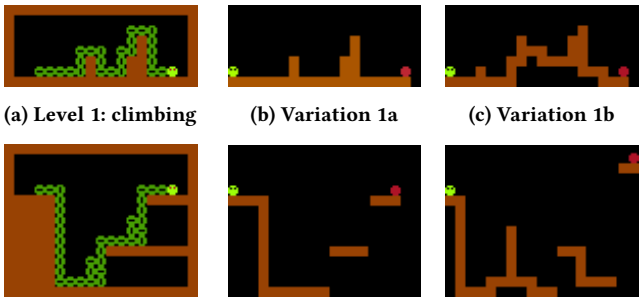
References

[1] Anders Bouwer and Riemer van Rozen. 2025. Towards Didactics-Driven Development of Educational Games. In *Foundations of Digital Games, FDG 2025 – Workshop on Procedural Content Generation, PCG 2025*. ACM.
[2] Tamara Dobler, Lorenzo Galeotti, and Riemer van Rozen. 2025. LogiCraft: A Game Modification Framework for Learning Propositional Logic. In *Foundations of Digital Games, FDG 2025 – Workshop on Tabletop Games*. ACM.
[3] Dylan Kroon. 2025. *Generating Personalized Puzzle Tutorials for Teaching Propositional Logic*. Master's thesis. University of Amsterdam. Ongoing project.
[4] Stephen Lavelle. 2015. PuzzleScript. https://www.puzzlescript.net
[5] Youri Reijne. 2021. *LINCO-PUVI Framework: Live Interactive Code Puzzle Visualisation*. Master's thesis. University of Amsterdam. Cum laude.
[6] Riemer van Rozen. 2025. Live Game Design: Prototyping at the Speed of Play. In *Foundations of Digital Games, FDG 2025*. ACM.
[7] Borja Velasco Santamaría. 2024. Echoes of the Labyrinth: Generating Puzzle Tutorial Levels and Solutions through Verb-Enriched Playtraces. Cum laude.
[8] Dennis Vet and Riemer van Rozen. 2024. The Puzzle Forecast: Tutorial Analytics Predict Trial and Error. In *Foundations of Digital Games, FDG 2024 – Workshop on Procedural Content Generation, PCG 2024*. ACM.

SEN 2025, May 23, 2025, CWI, Amsterdam, The Netherlands

(a) Easy **(b) Intermediate** **(c) Hard**

Figure 1: *Maze Crawler* levels generated by Daedale



(a) Level 1: climbing **(b) Variation 1a** **(c) Variation 1b**
(d) Level 2: snaking **(e) Variation 2a** **(f) Variation 2b**
(g) Level 3: avoid traps **(h) Variation 3a** **(i) Variation 3b**

Figure 2: *Lime Rick* level variations generated by Deadale

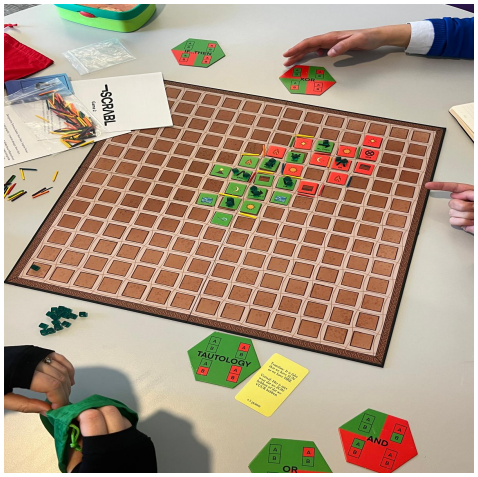


Figure 3: Playing ¬SCR∧BL at Hyperion Lyceum