P. Straubinger, L. Bloch and G. Fraser, "Engaging Young Learners with Testing Using the Code Critters Mutation Game," 2024 IEEE International Conference on Software Testing, Verification and Validation Workshops (ICSTW), Toronto, ON, Canada, 2024, pp. 322-330, doi: 10.1109/ICSTW60967.2024.00063.

This study introduces Code Critters, a game designed to teach software testing concepts to young learners in an accessible manner. The research addresses the gap in programming education where testing is often neglected or perceived as a hard task. Code Critters transforms testing principles into a tower defense-style game where players strategically place magical "portals" to distinguish between healthy creatures (correct code behavior) and mutated creatures (faulty code). The game uses block-based programming to make testing concepts accessible to younger audiences.

The researchers conducted an experiment involving 40 students aged 11-16 across two 90-minute sessions in January 2024. Participants had prior experience with block-based programming through Lego robotics but no formal testing experience. The study analyzed gameplay data to understand how children interact with the game, measuring their testing effectiveness through portal placement and mutant detection rates, and collecting feedback through exit surveys. The analysis used statistical methods to compare different groups of players, categorized by their gameplay behavior and progression patterns.

The study revealed three distinct player behavior patterns: disengaged players who showed minimal participation, methodical players who focused on understanding each level thoroughly, and speed-focused players who prioritized rapid progression. Overall, children played an average of 20 games, completed approximately 6 levels, and demonstrated effective testing by detecting 90% of mutants and correctly identifying 70% of healthy creatures. The exit survey showed that 63% of children found the game enjoyable.

This research demonstrates that gamification can successfully make software testing concepts accessible and engaging for young learners. The block-based approach proves effective for younger audiences, suggesting that similar strategies could be applied to other advanced programming concepts. For future research, the study opens for exploring how gaming elements can be integrated into broader computer science education and developing adaptive systems that can accommodate different learning styles and progression patterns observed in the three player groups.