

# Gamification: Using Logical Puzzles to Teach Abstract Concepts

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## ABSTRACT

Gamification is the process of adding interactive elements (games) to an environment not usually associated with games to promote engagement, interest and motivation. Gamification is becoming increasingly popular in education, with approaches such as points, badges, and leaderboards used to extraneously incentivise students to participate in their learning actively.

This paper explores the use of logic games as an auxiliary learning tool to help familiarise students with complex mathematical concepts in a more engaging way. Secondly, we aim to capture the impact of logic games on performance-affecting anxiety experienced by postgraduate students as they are introduced to the abstract concepts and logical reasoning used in a mathematical discipline such as Computer Science.

Mathematical anxiety (MA) is a feeling of apprehension when an individual is exposed to mathematical concepts. It is a significant concern for educators as studies have shown that MA strongly correlates with poor performance, especially among older students.

Students with little or no formal mathematical education – particularly postgraduate students returning to tertiary education from a non-mathematical field – are especially prone to MA. MA often manifests itself as an inability to grasp fundamental abstract concepts or reason logically.

Many popular games and puzzles have strong foundations in logic, requiring the user to reason about abstract concepts. Wordle, Sudoku, Baba is You, and Minecraft are some of the recent, hugely popular games built around a simple set of rules and clues that the user pieces together to infer a solution.

This study utilises qualitative research methods to assess the impact of the proposed teaching intervention. Postgraduate students undertaking a *Foundations of Computer Science* course were surveyed before and after being introduced to several interactive logical games and puzzles selected and built to explore several mathematical concepts introduced during the course.

Qualitative results captured in these questionnaires aim to address the following three research questions:

- RQ1: How do interactive puzzles affect mathematical anxiety in postgraduate cohorts?
- RQ2: How does the use of interactive puzzles affect postgraduate student performance?
- RQ3: What is the ideal balance of entertainment and education within a puzzle to produce the optimal outcome?

We hope this paper will provide valuable lessons for those designing and implementing logic games to motivate, engage, and enhance learning outcomes in mathematic education.

**KEYWORDS:** *Gamification; Interactive learning; Mathematical anxiety*