

## USING A VIRTUAL ESCAPE ROOM TO TEACH GEOLOGICAL TIME: AN ACTION RESEARCH STUDY WITH 10<sup>TH</sup>-GRADE STUDENTS

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### ABSTRACT

Teaching geological time is a persistent challenge in Geoscience education due to students' difficulties in conceptualising deep time and abstract temporal scales. This study aimed to design, implement, and evaluate the effectiveness of a Virtual Escape Room (VER) as an active learning resource to promote understanding of geological time among 10<sup>th</sup>-grade students. Grounded in a Game-Based Learning (GBL) framework and implemented within an Action Research (AR) methodology, the study focused on both cognitive and motivational dimensions of learning. The pedagogical intervention involved 23 students and comprised a sequence of challenges organised around three geological eras – Palaeozoic, Mesozoic, and Cenozoic. Data collection combined quantitative and qualitative techniques: (i) a post-test and delayed re-test to assess knowledge acquisition and retention; (ii) structured classroom observations; (iii) a snapshot report; and (iv) semi-structured interviews analysis. Quantitative data showed a improvement in students' performance. Observation grids indicated high levels of engagement and collaboration, while Likert-scale responses revealed uniformly positive attitudes toward the use of digital tools and game-based strategies. Thematic analysis of interviews highlighted the VER's ability to foster critical thinking, contextual application of geoscientific knowledge, and student autonomy. Nonetheless, challenges were identified, including time constraints, unequal group dynamics, and occasional technical limitations. Overall, results support the pedagogical value of VER in secondary science education. The study advocates for integrating digital and game-based methodologies to enhance motivation, conceptual understanding, and the development of 21<sup>st</sup>-century skills.

**Keywords:** Action research, Game-based learning, Geological time, Virtual Escape Room.

### 1. INTRODUCTION

A solid understanding of Earth's history relies on critical thinking strategies. However, the concept of geological time - although fundamental in geology education – is abstract and complex, making it particularly challenging for secondary students and susceptible to alternative conceptions [1–5]. Difficulties often stem from the vast temporal scales involved and from reconciling geological timescales with everyday notions of time [6,7]. Against this backdrop, the present study introduced a Virtual Escape Room (VER) to support the learning of geological time in an interactive and demanding way. Grounded in Game-Based Learning principles, the activity aimed to bridge traditional and