Role-Playing Games for Learning Calculus in Aerospace Engineering: Engagement, Peer Collaboration, and Deep Understanding

Sara Sanchez Lopez
Universitat PolitÃ¨cnica de ValÃ¨ncia

Abstract:

This project presents the implementation of a classroom-based role-playing game (RPG) as a learning tool in the Mathematics I course for first-year Aerospace Engineering students at Universitat Politècnica de València. The initiative aimed to foster deep understanding, increase motivation, and promote peer collaboration during exam preparation, focusing on key concepts in differential and integral calculus.

The activity was structured around a game master who guided the session, while student teams adopted specific roles and worked through challenges derived from real exam questions. The progression through the game included dice rolls, strategic decision- making, and problem-solving under time constraints. Each challenge was embedded within a fictional yet thematically relevant narrative connected to engineering and sustainability. Mathematical problems were adapted to reflect different levels of difficulty and team dynamics, encouraging shared responsibility and constructive dialogue among peers.

The game was conducted in-person to manage random events and evaluate outcomes. Students were grouped heterogeneously and engaged in collaborative reasoning, which reinforced content review while developing transversal skills such as communication, cooperation, and critical thinking.

Preliminary qualitative and quantitative data from student feedback and academic performance suggest that the RPG format contributed to a more engaging learning experience and a better retention of mathematical concepts. Students reported higher levels of enjoyment and active participation, as well as greater confidence in tackling exam- style problems.

This approach aligns with current trends in game-based learning and has the potential to be adapted to other STEM subjects. It demonstrates that integrating playful elements and narrative frameworks into technical courses can create meaningful learning experiences without compromising academic rigor.

Keywords:

Game-based learning, mathematics, aerospace engineering, peer collaboration, active learning.