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PST018 - ELECTRO LAND: REDOX REACTIONS LEARNING DIGITAL ESCAPE GAME

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ABSTRACT

Many students struggle with mastering the redox reaction topic due to their multi-step processes, including oxidation-reduction concepts, electron transfer, and the balancing of redox equations. To address this issue, an interactive escape game entitled Electro Land was developed using the Genially platform. Unlike traditional learning and teaching methods, this game combines gamification with curriculum-based redox chemistry content and it was designed based on the Analysis, Design, Development, Implementation, and Evaluation (ADDIE) instructional design model to ensure a structured and effective learning experience. The game embeds redox chemistry content where students must answer questions correctly to progress and ultimately “escape” the challenge. This gamified approach aims to enhance conceptual understanding and student engagement on the redox topic. Positive feedback from students suggests increased motivation, deeper comprehension, and overall satisfaction with the learning experience. The success of Electro Land indicates that similar gamification strategies can be effectively applied to other chemistry topics to foster an engaging and interactive educational environment.

Keywords – redox reaction, ADDIE, escape game, gamification

INTRODUCTION

Electrochemistry involves the transfer of electrons in reduction and oxidation (redox) reactions and is often considered one of the most challenging topics in chemistry, possibly because it involves processes that cannot be directly observed, such as electron flow, and ion movement (Lin & Wu, 2021). Traditional education focuses on teaching and learning through teacher-directed lecturing, where learners primarily watch and listen to the teacher, often leading to difficulties in understanding the topic (Junior et al. 2025). One effective strategy to enhance students’ understanding and overcome low motivation in challenging topics is the use of gamification, which incorporates game design elements such as rewards and immediate feedback to make learning more effective and meaningful (Jaramillo-Mediavilla et al. 2024). In a study by Clapson et al. (2023), ChemEscape Battle Box puzzles were developed for a General Chemistry course, incorporating topics such as redox reactions. Among the four puzzles in the game, Puzzle 3 – Metal Redox Properties was found to be the most challenging for students. The game includes exam-style questions, and students reported that they could relate the gameplay to the course's

learning objectives. Cahyadhi and Lutfi (2021) has developed the Red and Ox Game for Android mobile devices to help balance redox equations. Based on the significant differences between pretest and posttest results, the game has proven to be effective. This paper describes the development of a redox reaction escape game called Electro Land, designed for students to enhance students' understanding of redox chemistry, with particular emphasis on the topic of balancing redox equations. The escape game requires participants to solve all the puzzles and complete all the tasks to exit the game (Roig et al. 2023).

OBJECTIVE

The main objective of this product is to create an interactive platform that not only enhances understanding of the fundamental principles but also fosters enthusiasm for the topic. Additionally, it was aimed to enhance student engagement and motivation in learning redox reaction through a gamified digital escape room. Furthermore, the game was designed to provide accessible resources to the educators that can be integrated into their teaching practices.

DESCRIPTION OF THE PROJECT

The Electro Land (Figure 1) game was developed as an interactive learning tool for students at the pre-diploma, diploma, matriculation, and degree levels. The development of the game was guided by the Analysis, Design, Development, Implementation, and Evaluation (ADDIE) instructional design model to create structured and effective learning experience (Norouzkhani et al., 2025). The following phases outline the development of the Electro Land game based on the ADDIE model:

1. Analysis: An analysis was conducted to identify students’ challenges in understanding and applying the principles of redox reaction and balancing the reactions. The findings revealed that many students struggled with determining oxidation numbers, identifying oxidizing and reducing agents, and applying the balancing concepts effectively.

2. Design: The design phase included aligning game elements to learning objectives, creating the game’s structure, storyline and learning flow as well as embedding gamification elements such as time limits, rewards and feedback.

3. Development: The game was developed as a digital escape room using Genially, a web-based interactive media platform. The escape room had four checkpoints, each containing problems related to redox reactions. Students were required to solve all the challenges at each checkpoint to earn stuffed animals as rewards and eventually complete the game. The theme of each checkpoint included the following: checkpoint 1, throw the clown; checkpoint 2, mirror maze; checkpoint 3, horse race; checkpoint 4, the house of terror.

4. Implementation: The Electro Land game was embedded in the Chemistry for Pre Diploma II (CHM012) Massive Open Online Course (MOOC). This online course is available on UFUTURE, the online learning platform developed by Universiti Teknologi MARA (UiTM).

5. Evaluation: A structured Google Form was used to collect feedback from students on the effectiveness of the game in enhancing their understanding on redox reactions. The responses were then analyzed to identify areas for improvement.

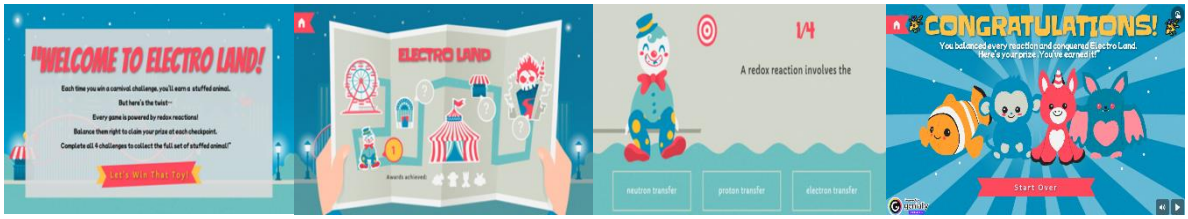

Figure 1: Image of the interface of the Electro Land game

NOVELTY

The novelty of the game lies in its integration of redox reaction concepts with a gamified escape room, developed using the free online interactive platform Genially. Unlike most existing games on similar concepts, which often employ simple game formats, Electro Land game offers an immersive learning environment enhanced with gamification elements. These features promote active learning, develops problem-solving and enhances students' motivation and engagement. Guided by the ADDIE model, it provides an engaging and pedagogically structured approach which is not found in the current chemistry education tools.

CONCLUSION

In summary, a virtual escape game in redox reactions represents an innovative approach that offers an alternative to passive online learning. This approach supports the development of gamification-based e-learning for higher education to create a more dynamic learning environment. Looking ahead, future developments will focus on expanding the game's content to include other electrochemistry concepts and adding more advanced interactive features and gamification elements. Additionally, further evaluation studies will be conducted to measure its effectiveness in improving learning outcomes across different educational levels.

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