

Finding connections between physical concepts by playing the game Physics Codenames

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Abstract. The paper presents an educational game called Physics Codenames, which aims to enhance pupils' comprehension of physics concepts. In the research, we observed the game process within three groups: first-year university students, pre-service teachers of biology, chemistry, and geography, and upper-secondary students. The clues and associated concepts were recorded, along with player discussions. The preliminary results indicate that playing Physics Codenames has the potential to develop a physics conceptual apparatus.

Introduction

Conceptual apparatus building is a crucial aspect of physics education. A proper comprehension and application of physics concepts allows for effective description and discussion of physical phenomena. Conceptual apparatus building occurs through conceptual change. Conceptual change refers to the creation of a new concept by restructuring elements of existing concepts. This process requires coordinated changes to many elements and their relationships within the mental structure. Conceptual change can involve both differentiation, where concepts that were originally perceived as one are separated, and integration, where a superordinate concept is created that encompasses multiple concepts whose relationship was not previously apparent [1]. Activation of the learner's prior knowledge and the learner's activity are important for inducing conceptual change [2].

The Physics Codenames

The Physics Codenames is a modification of the commercial game Codenames by MINDOK, authored by V. Chvátíl [3]. The objective of the modified game is to enhance pupils' comprehension of physics concepts. Because discussion and searching for common and distinguishing features, and associations with concepts used in games is a necessary strategy for winning, Codenames seems to be an ideal game for promoting discussion among pupils and development of conceptual apparatus. In Codenames, two teams compete and use clues to uncover their assigned concepts. Following the clue given by the captain, the team works together to identify the relevant concepts. They then select one concept and label it. If successful, they may proceed to label the remaining terms associated with the clue. Otherwise, it becomes the opposing team's turn. This game has been modified to incorporate physics concepts in place of the common terms that were part of the game. Another modification is that clues can include multi-word concepts, such as 'electric current' or 'change of position over time', rather than being limited to single words.

The Codenames game has been adapted for educational purposes in the Czech Republic to aid in the teaching of the Czech language [4]. However, the author emphasizes the importance of discussion and active peer participation to fully realize the game's educational potential.

Research

The research aims to investigate whether playing Physics Codenames promotes the development of players' physics conceptual apparatus.

The research was carried out on three groups of students. The first group comprised first-year university students studying physics, engineering physics, renewable energy, data science, and bioinformatics. They played a game with physics concepts from the field of mechanics. The second group comprises pre-service teachers of biology, chemistry, or geography in combination with another subject. Concepts that are common across science subjects, such as light, waves, system, motion, and pressure, were used in this group. The third group comprised upper-secondary students playing the game as a part of their physics lessons.

The game was observed, and the captain's clues and associated concepts were recorded, along with player discussions.

Preliminary results

Upon initial analysis of the game records, the clues can be categorised into several groups:

- Signs of physical quantities and their units,
- Physical concepts (such as barometer, electricity, and mass),
- Descriptive clues (that point out common properties or provide a simple description of a concept),
- Associations from everyday life (such as shadow play, yin-yang, or hairs).

The aforementioned types of clues encourage thought processes that lead to the development of conceptual understanding, such as identifying commonalities, differences, associations, and categorising concepts. Most groups engaged in discussions about physical concepts during the game, and these discussions continued beyond the game when players asked the captain to explain the clues.

Conclusion

The results indicate that playing Physics Codenames has the potential to develop a physics conceptual apparatus. The process of the game in the research groups will be observed again at the end of the semester. The paper will be enhanced with the students' viewpoints and opinions of the game.

Acknowledgements

This work has been supported by Slovak KEGA grant 059UK-4/2022 “Preparation of physics teachers for the use of non-formal and informal education”.

References (Vancouver numeration and APA Style)

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