# *Design an Online Escape Game on Gather Town to Foster Electrical Troubleshooting Skills*

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**Abstract**
Online learning has become increasingly important and widespread in the post-epidemic era. However, in the absence of adequate interaction, learners may lose motivation, attention, and experience anxiety, thus reducing learning efficiency. Game-based learning can improve student motivation and attention, and the integration of real-world scenarios and tasks into games is believed to promote learner engagement and induce learning transfer. Meanwhile, past research has revealed that integrating cognitive scaffolding into games can help learners engage in higher level thinking and problem-solving skills. This study presents a game-based learning approach that utilizes simulation and cognitive scaffolding as design to enhance learners' physics knowledge and troubleshooting skills through an online educational escape game named *"Electrician"*. The game is themed on an electrician maintaining a building's circuit system, and it includes a realistic setting created on Gather Town as well as a Google form integrated to offer NPC interaction and cognitive scaffolding. In this study, flow and anxiety were measured in six persons who were publicly recruited as participants. The descriptive statistics showed that learners scored above the median of 3 on each of the nine sub-dimensions of flow, with the mean scores for concentration, time distortion and loss of self-consciousness being higher than 4.00. The anxiety score of 3.15 was close to the median of 3.00, indicating that learners had moderate anxiety while playing. The preliminary findings indicate that the mechanism developed in this study is beneficial in enhancing learners' flow, high concentration levels, and moderate anxiety in learning, making it a valuable reference for distant education in STEM.

Keywords: Online Educational Escape Game, Troubleshooting Skills, Scaffolding

## Introduction

Due to the COVID-19 pandemic, educational institutions offer remote learning in subjects that were formerly taught face-to-face and through hands-on practice, including science. This sudden shift in the remote learning environment causes numerous challenges for students' education and makes it even more important to ensure efficient transfer of essential skills (Farros et al., 2020). According to Moorhouse et al. (2021), the physical separation and sense of presence between teachers and students distinguish synchronous online classrooms from traditional classroom settings. One of the reasons for the lack of motivation and engagement may also be because online learning is less likely to involve interaction with peers and teachers (Lakhal et al., 2017) and is often challenging to keep up with the pace (Almaiah & Almulhem, 2018; Al-Araibi et al., 2019).

Several studies have shown that incorporating collaborative problem solving and game-based learning into instructional activities can be an effective teaching strategy for science education (Bressler & Bodzin, 2016; Sung & Hwang, 2013) The findings of Wang et.al (2022) suggest that digital games are a promising teaching strategy in STEM education that can significantly increase student learning. In order to create a simulated real-life game environment on Gather Town for the *"Electrician"* online escape room educational game, this study used Google Form to design an interactive dialogue mechanism upon the game's non-player characters (NPCs). Realistic scenarios enable learners to focus more intently and become more immersed in problem-solving, which can significantly improve learning motivation and learning transfer (Catalano & Mortara, 2014; MeLellan, 1996). Additionally, research has shown that adding scaffolding to games can help players reduce their anxiety (Lin & Hou, 2022).

This game is themed on an electrician rectifying an electrical problem in a building and provides cognitive scaffolding as a clue in the Gather Town setting, such as the building circuit layouts, diagrams, logbooks, or by manipulating light bulb simulator to obtain implicit information. The goal of the game is for players to gain knowledge of electrical concepts (e.g., parallel and series circuit, Ohm's Law, electrical power, etc.) through dialogue with NPCs and scene exploration, and to use the information gathered in the game to discuss with peers, identify circuit problems, and propose solutions in order to develop learners' physics and troubleshooting skills.

## Research Purposes And Questions

This study integrates Google Form to develop an interactive dialogue mechanism for NPCs and Gather Town to replicate the setting of an electrician detecting electrical problems in a building, to design an online escape room educational game named *"Electrician"* so that learners can improve their flow experience and lessen their anxiety when learning online.

Research Question：What are the flow experiences and anxiety of learners who use *"Electrician"* for online game-based learning?

## Method

A total of six adults aged 20 years and above were recruited online to participate in this study. Participants were required to use a personal computer and play the game in an isolated space. The game uses Gather Town as a platform (Figure 1) for players to take on the role as an

electrician trainee, assisted by instructor Mark (the game's main NPC), in detecting and repairing electrical problems in the MEG building (the game's scene). The game is divided into three levels, and the player has 60 minutes to explore the scenes, including the electrical layout of the building, a light simulator, a weekly power consumption metre, and information provided by the game's NPCs as a cognitive scaffold, to detect the cause of the problem in each level (e.g. power outage, low brightness, high electricity bill).

When the learner believes that they have diagnosed the problem, they can always report their findings to instructor Mark. If the investigation is successful, Mark will provide immediate feedback as well as a pass code to guide the learner to the next level (Figure 2). The task level become challenging as the level progresses, facilitating collaboration between learners to solve all problems within the time limit. At the beginning of the experiment, the facilitator explained the process and rules of the game to the participants (10 minutes) and played the game (60 minutes). Participants answer a questionnaire on flow and learning anxiety at the end of the session (15 minutes).

In this study, the Chinese version of Kiili's (2006) Flow Scale, as translated by Hou & Li (2014), was used to assess participant flow experience. On a 5-point Likert scale, this scale contains 22 items, including flow antecedents and flow experiences. The questionnaire's reliability (Cronbach's alpha = 0.945) showed a high level of internal consistency. The Affective Filter Hypothesis created by Krashen (1981; 1987) was used to assess participant anxiety, and the Chinese version was adapted from the Learning Experience Scale by Hung (2001) to better fit the context of this study. The 8-item scale is based on a 5-point Likert scale. The internal consistency of the scale (Cronbach's alpha=0.748) was found to have a good level of reliability.

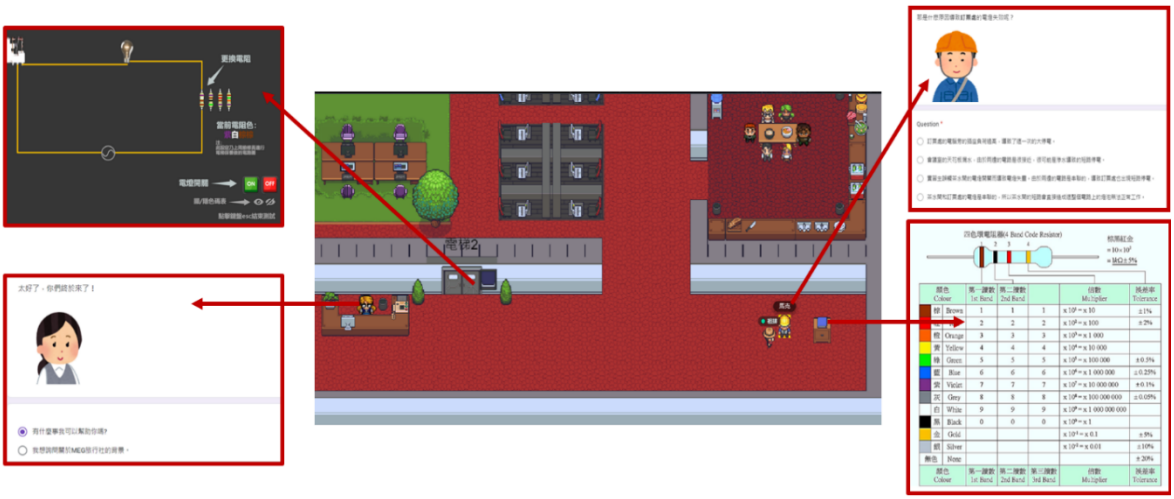

Figure 1. *Leaners explore the game's scene with cognitive scaffoldings in Gather Town*

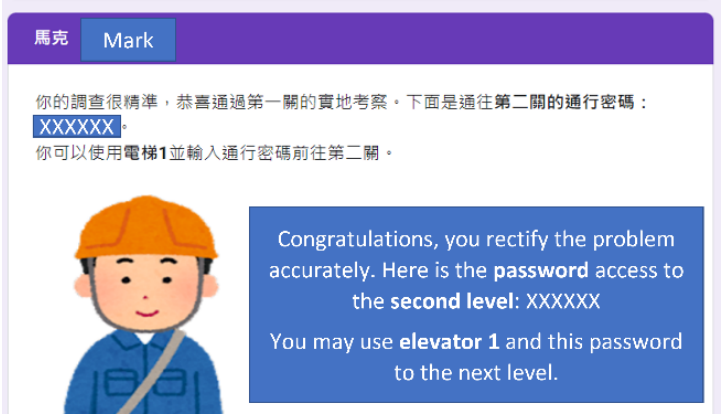


Figure 2. *Mark, the instructor, provides learners with immediate feedback and guidance*

**Results and Discussions**

*"Electrician"* is a room escape game in which players need to explore the scenes and interact with NPCs in order to detect electrical problems and build their understanding of physics and troubleshooting skills. Table 1 shows a Mann-Whitney U test of the flow experience of the learners after completing the game. The overall flow (M=3.80, SD=1.20) , the mean values for Flow Antecedents (M=3.42, SD=1.48), Flow Experience (M=4.13, SD=1.04), and all other dimensions were greater than the median of the scale (i.e.,3), with Concentration, Time Distortion, and Loss of Self-Consciousness significantly greater than the median of 3. This suggests that the game helps learners to remain engaged in the game's tasks while forgetting about the passage of time and self-awareness, resulting in a certain level of flow experience, which in turn improves learner concentration for online learning.

**Table 1.** ***The mean and standard deviation of learners' flow***

(n = 6)

| **Dimension** | *M* | *SD* | *Z* | *Sig.* |
|---|---|---|---|---|
| **Overall Flow** | 3.80 | 1.20 | 1.47 | 0.141 |
| **Flow antecedents** | 3.42 | 1.48 | 0.74 | 0.461 |
| Challenge-skill balance | 3.33 | 1.72 | 0.53 | 0.596 |
| Goals of an activity | 3.42 | 1.59 | 0.84 | 0.399 |
| Unambiguous feedback | 3.75 | 1.17 | 1.36 | 0.174 |
| Sense of control | 3.58 | 1.43 | 1.23 | 0.221 |
| Action–awareness merging | 3.00 | 1.90 | 0.00 | 1.000 |
| **Flow experiences** | 4.13 | 1.04 | 1.78 | 0.075 |
| Concentration | 4.29 | 1.07 | 2.00 | 0.045* |
| Time distortion | 4.33 | 0.82 | 2.07 | 0.038* |
| Autotelic experience | 3.67 | 1.69 | 1.19 | 0.234 |
| Loss of self-consciousness | 4.50 | 0.84 | 2.12 | 0.034* |

$^{*}p$ <0.05 , $^{**}p$ <0.01

The Mann-Whitney U test of learners' anxiety are shown in Table 2. The overall anxiety (M=3.15, SD=1.21) was not significant from the median of the scale (i.e., 3). Wang et al. (2015) suggest that a moderate level of anxiety increases learners' attention and motivation, indicating that this game generates a moderate level of anxiety for learning and is an important indicator of sustained flow experience.

**Table 2.** ***The mean and standard deviation of learners' anxiety***

(n = 6)

| **Dimension** | *M* | *SD* | *Z* | *Sig*. |
|---|---|---|---|---|
| **Learning Anxiety** | 3.15 | 1.21 | 0.53 | 0.596 |

$^{*}p < 0.05$ , $^{**}p < 0.01$

## Conclusions

*"Electrician"* is an online escape game based on the physics concept of electricity. The game incorporates cognitive scaffolding in the game scenes, simulations, and information provided by NPCs to enhance physics knowledge and troubleshooting skills. The above data show that the flow is higher than the scale's median (i.e. 3) and anxiety is not significantly different from the median of the scale. Preliminarily, the game design of this study increase the flow of learners and achieve moderate anxiety during the online learning process, assisting learners in developing relevant physic knowledge and troubleshooting skills. For future studies, more sample sizes can be included, as well as a more in-depth comparative analysis of ARCS, learning effectiveness, the usefulness of the game scaffolding, and game fidelity.

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**References**


Al-araibi, A. A. M., Mahrin, M. N. R. B., & Yusoff, R. C. M. (2019). Technological aspect factors of E-learning readiness in higher education institutions: Delphi technique. Education and Information Technologies, 24(1), 567-590.

Almaiah, M. A., & Almulhem, A. (2018). A conceptual framework for determining the success factors of e-learning system implementation using Delphi technique. Journal of Theoretical and Applied Information Technology, 96(17), 5962-5976.

Bressler, D., & Bodzin, A. (2016). Investigating flow experience and scientific practices during a mobile Serious Educational Game. Journal of Science Education and Technology, 25(5), 795–805.

Catalano, C. E., Luccini, A. M., & Mortara, M.(2014). Guidelines for an effective design of serious games. International Journal of Serious Games, 1(1).

Farros, J. N., Shawler, L. A., Gatzunis, K. S., & Weiss, M. J. (2020). The Effect of Synchronous Discussion Sessions in an Asynchronous Course. Journal of behavioral education, 1-13.

Fuentes-Cabrera, A.; Parra-González, M.E.; López-Belmonte, J.; Segura-Robles, A. Learning mathematics with emerging Methodologies—The escape room as a case study. Mathematics 2020, 8, 1586.

Jambhekar, K.; Pahls, R.P.; Deloney, L.A. Benefits of an escape room as a novel educational activity for radiology residents. Acad. Radiol. 2020, 27, 276–283.

Kuo, H.-C.; Pan, A.-J.; Lin, C.-S.; Chang, C.-Y. Let's Escape! The Impact of a Digital-Physical Combined Escape Room on Students' Creative Thinking, Learning Motivation, and Science Academic Achievement. Educ. Sci. 2022, 12, 615. https://doi.org/10.3390/educsci12090615

Lakhal, S., Bateman, D., & Bédard, J. (2017). Blended synchronous delivery modes in graduate programs: A literature review and how it is implemented in the master teacher program. Collected Essays on Learning and Teaching, 10(2017), 47–60.

Lin, Y.-C., & Hou, H.-T. (2022). The evaluation of a scaffolding-based augmented reality educational board game with competition-oriented and collaboration-oriented mechanisms: differences analysis of learning effectiveness, motivation, flow, and anxiety. *Interactive Learning Environments*, 1–20. https://doi.org/10.1080/10494820.2022.2091606

López-Pernas, S.; Gordillo, A.; Barra, E.; Quemada, J. Examining the use of an educational escape room for teaching programming in a higher education setting. IEEE Access 2019, 7, 31723–31737.

Manzano-León, A.; Rodríguez-Ferrer, J.M.; Aguilar-Parra, J.M.; Martínez Martínez, A.M.; Luque de la Rosa, A.; Salguero García, D.; Fernández Campoy, J.M. Escape Rooms as a Learning Strategy for Special Education Master's Degree Students. Int. J. Environ. Res. Public Health 2021, 18, 7304.

McLellan, H. (1996). Situated learning: Multiple perspectives. Situated learning perspectives, 5-17.

Moorhouse, B. L., Li, Y., & Walsh, S. (2021). E-classroom interactional competencies: Mediating and assisting language learning during synchronous online lessons. RELC Journal, 0033688220985274.

Sung, H.-Y., & Hwang, G.-J. (2013). A collaborative game-based learning approach to improving students' learning performance in science courses. Computers in Education, 63, 43–51.

Wang, L.-H., Chen, B., Hwang, G.-J., Guan, J.-Q., & Wang, Y.-Q. (2022). Effects of digital game-based STEM education on students' learning achievement: a meta-analysis. *International Journal of STEM Education*, *9*(1). https://doi.org/10.1186/s40594-022-00344-0

Wang, Z., Lukowski, S. L., Hart, S. A., Lyons, I. M., Thompson, L. A., Kovas, Y., ... & Petrill, S. A. (2015). Is math anxiety always bad for math learning? The role of math motivation. Psychological science, 26(12), 1863-1876.

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