**Level 1 | Comparing Learning Games to Simulations (Beat the Boss!)**


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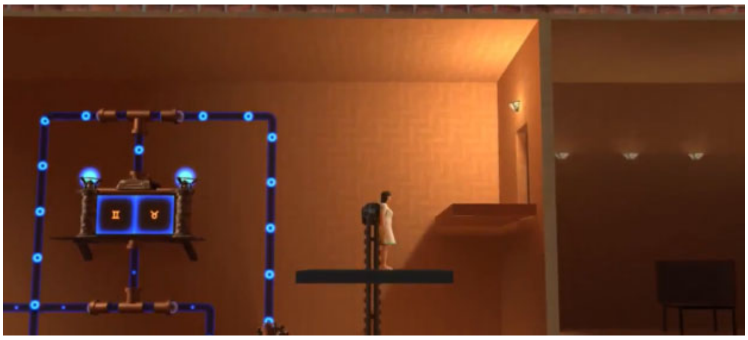
**<u>Game #1 Title: WIRED THE GAME</u>**



This game is a puzzle and platformer game. The characters involved are a young man who claims to have created this place, an older man, a chap, and a strange young lady. She has an appointment outside the school but falls into a trap and must go through all floors and rooms to escape and meet her host. The story involves electricity, mechanical machines, and physics phenomena. The player is challenged to access rooms by activating mechanical machines by wiring the start and end of an electrical cable.

**Core Dynamics**

The game's core dynamics is "Escape," as the player must solve puzzles to find the exit.

**Main Mechanics**

A player can move. They can walk, jump, and climb ladders. They can also drag and drop cables to connect sockets and wires. Electric wires can close circuits, whereas mechanical machines can lift and move panels out of the way. Players use horizontal panels to jump between platforms. Players can also view videos and click on computer screens to obtain information and puzzle hints.

**Learning Objectives**

The game aims to guide players in learning about basic circuits. Some of the learning objectives this game could claim are:

- ✓ Recognize batteries and generators create current.
- ✓ Describe current flowing in a circuit, from the negative end to the positive end of a battery.
- ✓ Examine circuit diagrams to determine how current flows.
- ✓ Explain how a simple switch can be used to control the flow of electrical energy (close, open, and short a circuit).

Also, the game may have had some learning objectives about mechanical phenomena, using cogwheels and other engineering machines. However, I wonder if there were any specific ones since this game focused on learning about electricity.

**Learning Domain & Experience**

Teaching will use different techniques, whether focusing on the lowest levels of Bloom's taxonomy (Iowa, n.d.) for which facts are learned and applied or when exploring concepts, rules, and procedures. When the learner progresses toward Bloom's higher levels, such as evaluating and creating, teaching techniques and gamification will also evolve to match the targeted level. Moreover, Kapp (2012, Chapter 8) classifies learning domains into four different types of knowledge: factual, rules, conceptual, and procedural. Moreover, Kapp (2012, Chapter 8) asserted that designers should implement specific mechanics well aligned and reflecting the targeted knowledge.

For all these reasons, I expected that the game mechanics would reflect the targeted type of knowledge and align with the learning objectives. Indeed, there needs to be more deep thinking, synthesizing, or analyzing skills involved in the gameplay. The player gets access to clues in given places. The mechanics of game #1 challenge the player with connecting wires to close circuits and get the current flowing where needed. There are psychomotor skills with the player having to walk, jump, and climb ladders, all acquired quite easily. Overall, the game provides a pleasant coherent gameplay experience at a basic level of learning.

<u>**Game #2 Title: CIRCUIT WARZ**</u>


The game's plot involves aliens attacking Earth. Some weapons are sabotaged and broken. The gameplay embarks the player/learner into solving increasingly more difficult electrical puzzles. According to Callaghan (2014), the game design philosophy is to have the player succeed through “the practical application of circuit theory” but “under severe time constraints”. The electronic components have been made more prominent, and the environment resembles the inside of an integrated circuit. The author also mentions that the game offers multi-player and Virtual Reality implementations.

**Core Dynamics**

Players are engaged in a core dynamic of finding a “solution”. For each level, there is a specific problem to solve.

**Main Mechanics**

The game uses the player’s movement mechanics- a gamification technique, according to Kapp (2012, chapter 8) - to reach locations where electronic components are positioned. A hand tool is used for rotating and selecting components presented using a carousel. The player receives hints and can visualize various information (on screen, using labels), such as circuit diagrams, technical information, and giant question marks.

**Learning objectives**

Education aspects are found in the training section of the game website (Callaghan, 2014b). The game explores seven levels, each with a different focus. Each level has one learning objective(s) and requires the application of a specific formula and analyzing the problem using a set of concepts. I summarized the learning objectives as follows:

- Solve for a resistor value given other component’s value, a specific schematic, and an expected voltage or current output.

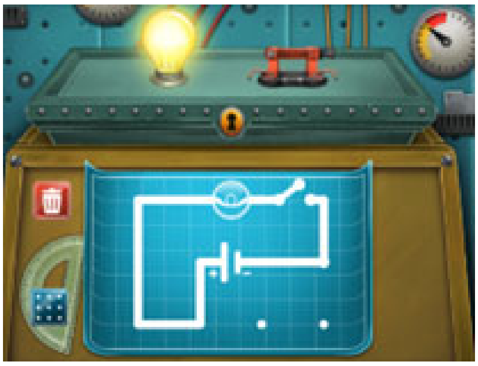
The game’s purpose is a summative assessment, as it verifies that learners know how to apply formulas. The game classifies as a mix of declarative (formula memorization) and some conceptual knowledge about electronic circuits (knowledge type classification as per Kapp, 2012, chapter 8).

**Learning Domain & Experience**

The mechanics of selecting the right components, like in a multiple-choice quiz, does not provide the learning experience of solving the problem. This interaction is typically seen in an instructional design paradigm but is not aligned with training an engineer in the real world. The game disappoints with the techniques used to support the player's learning experience. This lack of alignment and cohesiveness might explain why some players (like a classmate mentioned in our class forum) cannot make sense of the game and abandon play.

**<u>Game #3 Title: CRACK THE CIRCUIT</u>**

The player must observe a simple circuit with one or more bulbs, batteries, and switches. Underneath the circuit is a box hiding how components are connected. Players must experiment and try to figure out how the circuit is wired. We can draw and submit a sketch of the circuit diagram. You win when the diagram matches the actual circuit. There are 18 levels and a free draw mode with 4×3, 5×4, and 7×5 grids.



The game contextualization provided some elements of fantasy and some functionality as the light bulbs react to a proper circuit diagram. There is also a red light and sound animation when a player creates a short-circuit.

**Core Dynamics**

Players are "matching" a circuit diagram with the actual hidden circuit. Once the circuit is closed, the game tells the player if the real-world implementation hidden in the box fits the specific visual and normative description provided.

**Main Mechanics**

The player can draw wire lines, drag and drop components, and activate a circuit switch to open/close. The light bulb has a unique lighting effect of reacting to the current flowing. Each level is a puzzle with increasing difficulty. The player must solve puzzles with a specific core loop (concept defined by Eng,, 2019):

1) Observe an actual circuit with mystery parts and click as instructed to get started;
2) Guess and sketch the associated circuit;
3) If successful, the box opens underneath the circuit and reveals the hidden parts. Players can go to the next level;
4) If the diagram is incorrect, the box does not open yet.

**Learning objectives**

After playing the game, players will gain specific knowledge and skills. They will be able to:

- Sketch a simple circuit powering a light bulb.
- Identify some essential components of a simple circuit.
- Explain how to close, open, and short a circuit.
- Examine series and parallel circuits diagrams to determine how current flows.

I classified these objectives as low-level Bloom's taxonomy. Learners must know and comprehend how a basic circuit works and how to sketch diagrams accordingly.

**Learning Domain & Experience**

The author has designed levels to be "more difficult and challenging as the players move toward the end of the game," as described by Kapp (2012, chapter 3), which results in "educational advantages but also maintain interest" (p. 67).

Scaffolding is accomplished first with short instructions to get started for the first levels as they make the player focus and think about one concept. Then, the circuit involves more components and new concepts. For example, level 4 introduced parallel wiring. Help is available with a question mark button. The last levels had three light bulbs, and the player could use prior know-how acquired with two light bulbs.

Overall, the game aims to teach the learning domain described by Kapp (2012, chapter 8) as conceptual knowledge (how a current flows in a basic series or parallel circuit). There are also elements of declarative knowledge because players could improve their basic knowledge of simple circuit components as they play the game.

**Comparison of all Games/simulations Played**

When comparing games #1, #2, and #3, I looked first at the elements of simulation since they are presented as a subset of games in a Venn diagram provided by Boler (2014). Game #1 provided an unrealistic electrical engineering environment and learning how to close/open a circuit and use a generator/battery. Overall, the environment did not create a real-world experience in learning about electricity and performing as an engineer would.

According to Narayanasamy et al. (2006), simulators offer a realistic environment with an elaborate interface and no compromise on input. Therefore, we would expect a “functional mock-up” (p. 13). However, game #2 features graphic objects that look like electronic components and a background with an integrated circuit but the interactive components are not part of it. Finally, the mechanics of multiple choice is a typical learning feature but a relatively limited input choice for an actual simulation. This game simulates a multiple choice but is not the functioning of electronic circuits, and, therefore, like game #1. It cannot qualify as a simulation.

On the other hand, Game #3 (Crack the Circuit) involved simulation for sketching a circuit diagram. The diagrams created are realistic, symbols are correct. According to Boller (2014), simulations focus on problem-solving and guide learners with making decisions that “mimic what you would have to do in the real world” (para. 5). Lights go on when appropriately connected, and the circuit burns if shorted. In addition, game #3 has hidden parts of the actual circuit, adding a gaming and mystery component. There also exists a win/lose end-state. Therefore, game #3 is classified not just as a simulation but as a simulation game.

**Motivating Factors Related to Learning Within Each Game/Simulation**

Contextualization for game #3 provided some elements of fantasy and some functionality as the light bulbs react to a proper circuit diagram. For example, a short circuit is noticeable as the bulb light gets red and the game engine plays a sound. These elements supported some of Lepper's instructional design principles for intrinsic motivation, as described by Kapp (2012). However, the game provided few controls, and challenges were somewhat repetitive. My experience could have been more varied but was quite monotonous.

Game #3 was "meant to be played in one sitting" (Kapp, 2012, p.65), while games #1 and #2 have a save function. For all three games, re-playability is limited to one set of content, with no random input or alternate path to make replay more attractive. Therefore, the games missed the benefits of spaced practice typically associated with multiple sessions.

In addition, games #3 and #2 did little to appeal to my curiosity and missed elements that would "enhance the gameplay experience" (Boller &Kapp, 2017, p.7). As mentioned in the ARCS model, Malone's motivation theory, Lepper's instructional design principles, and the taxonomy of intrinsic motivation for learning (as cited by Kapp; 2012, chapter 3), curiosity is a significant factor in motivating learners. Game #1 had some intriguing machines, making me wonder how things would work and triggering my curiosity.

Finally, I examined if the games leveraged episodic memory as described by (Kapp, 2012). Game #3's aesthetics of the wires inside the box are not attractive and quickly forgotten. In addition, the mystery circuit is only revealed after the player has completed the correct sketch and has been given positive feedback. With such a sequence of events, the player's attention is not geared toward visualizing the hidden part of the circuit but instead getting the answer correct. Game #2, with its giant components, did a better job of making for a vivid memory.

Unfortunately, remembering an experience about selecting a resistor in a carousel does little to achieve the targeted learning objectives.

Overall, games #2 and #3 appeal more to extrinsic motivation than intrinsic (as defined by Kapp, 2012, chapter 3). The player must succeed due to external pressure, but the game does not aim to grow the player's skills other than being able to solve problems under constraints. External motivation does not carry as much potential as intrinsic motivation to deliver quality learning experiences and performance opportunities. On the other hand, game #1 used social and emotional connections with the characters present, which helped to activate intrinsic motivation. Because other games have no characters, the player seems to be alone, not communicating with anyone, just doing one task after another, solving puzzles for the sake of it. That makes it a lonely environment and challenging to keep motivated.

**Conclusion**

After I had examined games through motivation theories' lenses, I could explain why some games, such as game #2, could be an award-winning game despite the misalignment between game mechanics and learning objectives (that made for a poor experience for me). Its environment, aesthetics, and mechanics were able to create a vivid impression and possibly activate many people's curiosity. I can also better understand how to improve game #3 to make it more "pleasantly frustrating" (Kapp, 2012) by leveraging more motivational theories. For example, adding characters, improving the aesthetics of the hidden wires, changing the sequence of events, introducing a self-assessment comparing the circuit and wiring, and letting the game engine provide feedback if the player is correct.

When I was learning from our course's resources about the differences between simulation, serious/learning games, and other games, I found the Venn diagram provided by Boller (2014) self-explanatory. It made sense that a simulation demonstrating how things work must work at the heart of a serious game, especially for STEM topics. This way, learners can practice skills and make mistakes as they learn, all in a safe and realistic environment. In addition, scaffolding could be put in place to show/hide some of the underlying simulation elements and provide for a learning progression.

Furthermore, I would distinguish ‘simulation’ from ‘simulation game’ by looking at the seven identifying characteristics defined by Narayanasamy et al. (2006). For example, whether or not the “skills development” aspect is present and if the simulation game was used as part of actual training. One of them is critical and also mentioned by Boler (2014), the presence or absence of an end goal. Simulations do not have them, while simulation games, like any game, would feature a winning/losing state designed for players’ enjoyment.

Finally, a game could feature an “abstraction of reality” (Kapp, 2021), not being realistic and flexibly mimicking the real world using fantasy, for example. Players could learn some bits, but a game is not typically designed to achieve specific learning objectives.

**REFERENCES**

Boller, S. (2014). Games vs Simulations: Choosing the Right Approach for Learning Links to an external site. Retrieved from the Knowledge Guru.

Boller, S. & Kapp, K. (2017). Chapter 1 The Basics. In Everything You Need to Know About Designing Effective Learning Games Play to Learn. pp. 6-8

Callaghan, M. J. (2014a). Circuit Warz, re-imagining engineering education. About. Retrieved from http://www.circuitwarz.com/General/about.html.

Callaghan, M. J. (2014b). Circuit Warz, re-imagining engineering education. Training levels. Retrieved from http://www.circuitwarz.com/Game-Apps/training.html.

Eng, D. (Dec. 2, 2019). Core Loops. Retrieved from https://medium.com/@davengdesign/core-loops-c98b1197e93d

Iowa State University, Center for Excellence in Learning and Technology. (n.d.) *"Revised Bloom's Taxonomy"* Retrieved from**: https://www.celt.iastate.edu/teaching/effective-teaching-practices/revised-blooms-taxonomy/**

Kapp, K.M. (2012). Chapter 3 – Theories behind gamification of learning and instruction. In The gamification of learning and instruction: Game-based methods and strategies for training and education. San Francisco, CA: Pfeiffer.

Kapp, K.M. (2012). Chapter 8 – Applying gamification to learning domains. In The gamification of learning and instruction: Game-based methods and strategies for training and education. San Francisco, CA: Pfeiffer.

Kapp, K. [Karl Kapp], (2021*). Games vs. Simulations*. [Video] YouTube. https://youtu.be/j6wemosp2sw

Narayanasamy, V., Wong, K. W., Fung, C. C., & Rai, S. (2006). Distinguishing games and simulation games from simulators. *Computers in Entertainment (CIE)*, *4*(2), 9-es