LEVEL 4 | Digital Game Design Document & Construct 3

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Graduate Certificate Serious Game and Simulation Design Designing Games for Learning

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Game Title
When Dragomir met Ava and her friends

Game URL
https://kay6.itch.io/dragomir-ava-circuit-led
and additional mechanics here:
https://nicholasstrzelecki.itch.io/7384-level-4-game-exit-sign-levels

Learner/Player

The primary target for the game is electrician apprentices, middle and high school students. They could play this game as part of their Physics curriculum. In addition, lifelong learners interested in studying how to create a simple circuit with a LED could enjoy the game and its embedded learning experience. The game is gender-inclusive, featuring diverse characters and using common pronouns (they/them/theirs, she/her/hers, and he/him/his).

As per Gee's principles (2013), summarized by Tozk (2014), customization will make the game more attractive to diverse players and learning styles. For this version, we used a limited set of images licensed on Shutterstock and catered mainly to middle school students. Additional graphic material will be required to attend to our larger audience and provide different aesthetics.

The game activates simple mechanics so learners with limited game experience can easily play. However, there are challenges designed for higher orders of thinking (as per Bloom's taxonomy) which makes the overall experience geared toward pleasant learning rather than pure entertainment.

As cited by Kapp (2012, chapter 6), Bartle's classified player types into four categories: the killer, the socializer, the explorer, and the achiever. Our game is targeted mainly at the achiever but could attract other types of players. According to Kapp, achievers "strive to accomplish the goals of the game. Their primary enjoyment is the challenge" (p. 133). Characters are friendly and display emotions, which could please socializers. Adding a leaderboard could also activate a competitive spirit for these players. However, a killer player may not find it funny that destroying a circuit's componenet is interpreted as an incorrect manipulation and not rewarded. The game is designed so that this loss of life would make the player reflect on the importance of thinking before acting. In terms of exploration, the garage setting offers some wandering around. The players can walk into the various areas to reach all the exit signs they must light on. However, the time constraint plays against a full exploration of the garage since players must focus on effectively using their time. However, still, explorers could enjoy strategizing with implementing different solutions.

Subject Area and Learning Domain

Players explore basic electronics and electricians' job constraints. They have to implement a simple circuit. It will power a Light Emitting Diode (LED). A LED emits light when electrical current flows through it. However, LEDs are fragile and will be destroyed with a current of more than 30mA. However, they also require sufficient voltage (typically more than 2 volts) to work. The player will have to place a resistor component to manage these constraints. Since resistors come with standard values, there will be more than one solution, which may not be a perfect fit. Resistors could be a good enough fit.

Kapp has delineated four knowledge domains (2012, Chapter 8) and their associated gamification techniques. Our game is aimed toward two of these specific learning domains. First, learners must understand the concepts that the current depends on the applied voltage and resistance. Regarding the conceptual learning domain, Kapp asserted that games could "immerse[s] the learners in the concept and let them experience it" (p. 175). Our game offers an initial immersion experience where the player has to figure out how things work by experiencing parameters in the circuit. The game provides current flow values when the player changes resistance values. The experience will initially guide the player into making sense of the concept.

Secondly, players will have to strategize to become faster and better at making choices. They will also learn they could use a graph or an equation to quantify the current versus voltage using Ohm's law and appropriately set parameters (such as the resistance) to manage time and effectiveness constraints. The game provides examples with a random twist and a role-play setting for this kind of procedural learning. The game allows players to experience learning content in a safe environment. In addition, an "immersive process allows the learners to experience a concept first-hand and can be used to provide both examples and non-examples of the concept in action" (Kapp, p175). This game also fits the" Mimicary" pattern of play. According to Kapp, "In mimicary, players assume the role of others or a role they do not currently poses" (p. 139). In this game, the player is an electrician hired to complete a job. They assume the character's role and are put through a real-world scenario that they will experience in the field.

Learning Objective(s)

MAGER (from course content) provided an A, B, C, D format (Audience, Behavior, Condition, and Degree), which was used to reformat our initial learning objectives as follows:

Players will be able to solve as many puzzles as possible during the allotted time using simulation of electrical laws and drag and drop of resistance into an electrical circuit with an LED. Players optimize the LED's brightness the best possible way.

When learners solve the proposed puzzles, they must analyze a circuit's components to figure out how all elements are interrelated. They look at the standard values of available resistor supplies and assess which values could work. Also, they cannot test/calculate all simultaneously, as it will make them spend too much time on the task. As a result, learners must strategize and optimize the resistor's implementation, which is a higher order in Bloom's taxonomy we wanted to aim for with this game.

Secondary objectives help players connect what they learn and practice in the game to physics content such as Ohm's laws, units for voltage, current, and resistors, and behavior on the job when constraints of time and imperfect supplies come into play.

1) What tasks (mechanics) must be demonstrated to achieve that learning objective?

A learner must demonstrate speed, accuracy, and effectiveness. A player estimates the appropriate current flow given by a random generator and different LEDs and their associated datasheet. In addition, a player analyses options and investigates the best course of action. A player could decide to spend more or less time doing simulations rather than estimating using Ohm's law (graph and equation representations) or settle on what seems good enough brightness to move faster between spots.

2) How are you scoring each of the tasks associated with the learning objective?

There are three counters strongly correlated to the learning objective:

- the number of puzzles solved with a good enough brightness level (80%). This counter relates to the speed of doing the job and accepting imperfect good enough solutions.

- the overall brightness of all LEDs installed. An average value is calculated so the player can assess the impact of each puzzle solved. This score increases when the player can make faster and better estimations and reach the best brightness more often and when possible.

- the time elapsed and the remaining time available. This counter forces the player to make trade-offs and show flexibility with limited supplies in hand. This counter generates stress and measures the ability of the player not to panic, remain calm, and produce effective results.

A fourth tracking number that comes into play is the number of LEDs burnt compared to the supply available. It may not impact the performance if this number remains low enough as human errors are expected. The rate could be customized with a player's level. More difficult for a more advanced player (5% of burnt LEDs permitted) and easier for a rookie electrician apprentice (up to 15% extra provided). When there are no longer any LEDs available but still puzzles to solve, the player could purchase new LEDs at a cost (to be designed in another version, just an idea here). The player will accept that not all puzzles will be solved or play again.

3) What are the connections to the subject area and learning domain?

A player will experience the intricacies of having an appropriate current flow in a circuit when there are parameters and constraints in play and stress with limited supply and time constraints, like in a real-world job. Players could use the game to evaluate their readiness for an exam, or it could also be included as a formative evaluation in a curriculum.

Goals of the game

A player wins a "good" or "great" electrician award, see figure 1 below. At the highest level, the game intends to motivate trade apprentices to investigate the subtleties of becoming a great passionate trade person compared to a good trade worker. At a lower level, it helps apprentices to evaluate their understanding of implementation risk for an electrical circuit with LEDs knowledge and skills, to experience failure in a safe environment, learn from it, and improve. Finally, it provides a way for students to assess how a stressful environment could impact their logical thinking. They could use the various counters and feedback

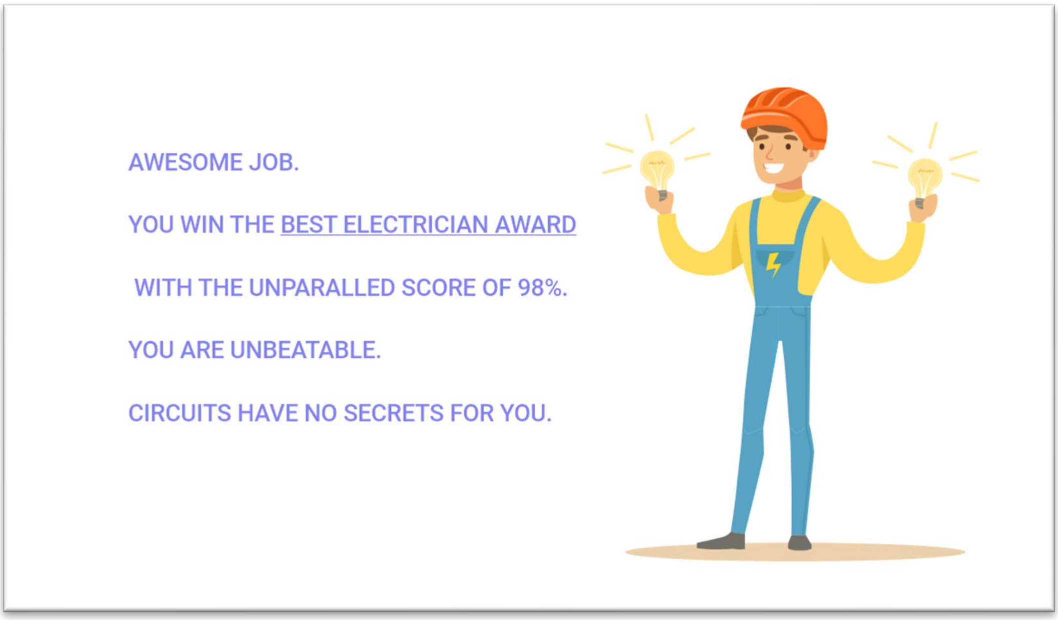


Figure 1: game goal – BEST electrician award

provided all along to realize their choices could be better if they had managed their stress better. This new awareness could lead to seeking learning in this area.

Game Description and Environment

The game environment setting is in a garage. The garage setting provides a gloomy, dark, and realistic environment that becomes brighter with the player's work. The story takes place in the 21st century, and the garage is the underground parking of a large US city office building. Its construction is in the process of being completed. There is no car parked yet, see figure 2 below. Players must move within the garage and reach the "Exit Sign" electrical boxes via ladders.

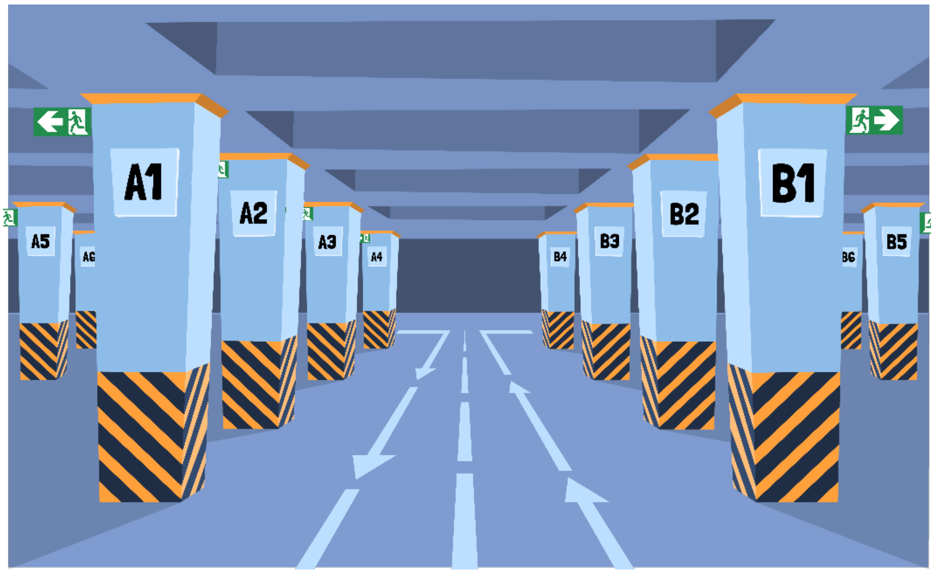


Figure 2: Garage is empty and dark, no light.

Players will open boxes containing pre-installed components such as a battery, wires, and a LED as a character. The LED has some knowledge about its characteristics. The player could learn about these with a Q&A dialog offered as an option, or the player could pull the LED's datasheet (a faster process requiring a better understanding of the data involved), or the player could ignore the LED altogether (and probably fail). There is also a battery (randomly set voltage) and a placeholder for a resistor. Players have several options: they could ask the computer to calculate the current flow given a resistor value (this is the simulation/test button), or they could look at a current versus voltage graph (using the graph button) for Ohm's law and a specific resistor. They could also review a set of circuit formulas by clicking the corresponding button, see figure 5 below.

The player must decide which tool is important and useful and which is not since the game is designed to work to reach Bloom's higher levels of learning. In addition, a timer provides overall time constraints because the customer needs this done as soon as possible. Players may run out of time and must decide if they want to get the best fit for a LED or complete all boxes in time, even if that means leaving some boxes with a good enough fit.

Learners could discover new concepts and procedures with real-world applications in a safe and controlled environment. They could also apply these concepts if the subject were already partly taught in the classroom before playing. They could assess their level of proficiency if they are already familiar with all the concepts and procedures involved.

The interactive game provides motivation and evaluation of skills for learners to learn concepts and procedures in a way that involves thinking and strategizing while evaluating how to use the information provided smartly. Many apprentices are reluctant to read instructions and datasheets because they like to jump into action quickly. However, today's jobs require planning and awareness of risks. The game could help learners better understand the skills they will have to develop to become great trade persons and enjoy their life at work, aiming to be the best at what they do but still keeping in mind real-world constraints. The game does not force the player to look at datasheets or formulas. It intends to guide players to use them when needed so that they can work more effectively.

A player must click an icon switching the camera viewpoint to the top view to make a move. Then the player can move to any area in the garage using a mouse, arrows, or W, S, A, D keys. The garage contains twelve parking stalls of similar size and shape. There is one exit sign per stall (green rectangles shown in the figure 3 below) located at the exact relative location near the corner concrete pile.

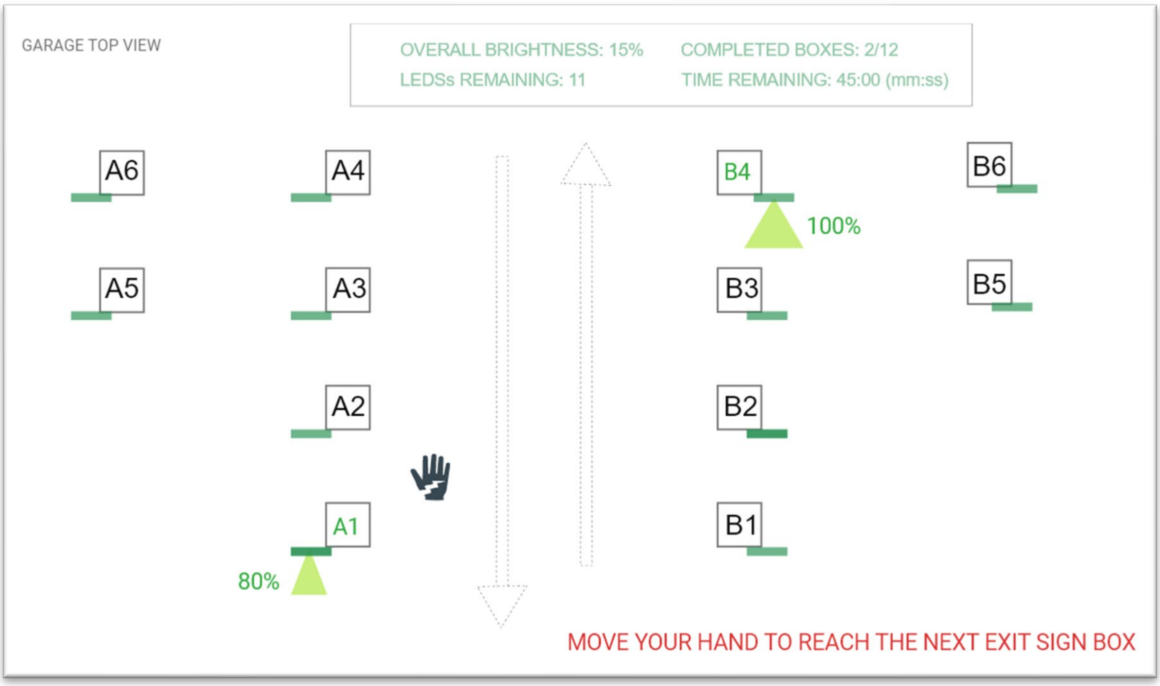


Figure 3: Top View Garage

Once the player has walked to the area they want to complete, they switch to front view and find the ladder in place and use it to climb up and reach the exit sign. The camera shows the player and a ladder on the left- or right-hand side, see figure 4 below.

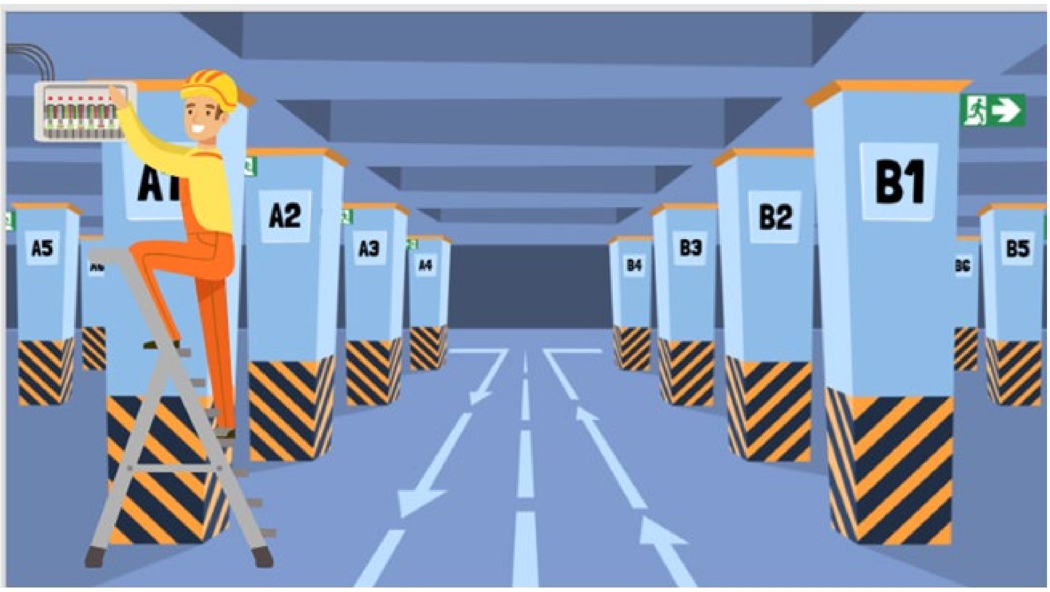


Figure 4: Player has climbed the ladder and reached the electrical box

The camera zooms in, and the player clicks on the box to discover the wiring inside. When the box is opened, the LED smiles and waves its hand. The player can click on the 5 buttons located in the bottom bar: formulas, graph, test(simulation), and datasheet. The player can activate scene change and the game will display a new digital minimalist environment with a white background with placeholders and arrows to continue and follow the guidance provided, see figure 5 below.

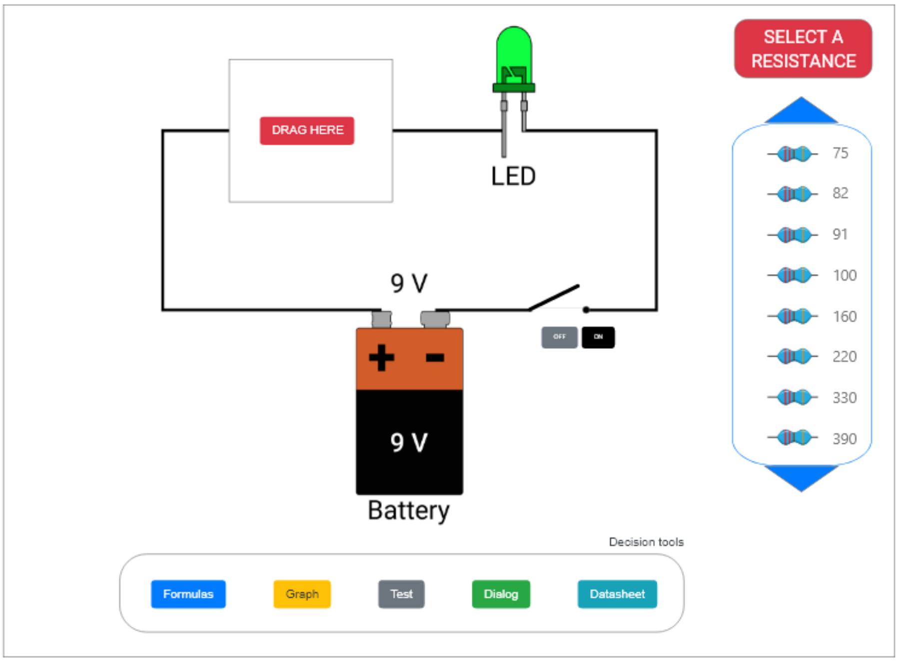


Figure 5: Inside the box tools and resistance drag and drop

Once a player has set their mind on a specific resistor value, they click on the resistor icon at the top right-hand side of the screen, and it shows an overlay with all standard resistors. The players drag and drop the resistor into the circuit and then close the circuit's switch (press button ON) to receive feedback about the work done. The player could decide to leave things as they are or change the resistor. Then, the game repeats 12 times for the 12 different locations. As suggested by a classmate, at the end of the game, when the brightness reaches 90%, an extra surprise could suddenly appear. It is an additional reward for which a sponsor could be found at a local level. The surprise is customized locally when used by a teacher in a classroom and could be adapted to other settings.

Story, Narrative and Characters

The player's name is Dragomir (for this version). He is an electrician apprentice with a job to do in a parking garage. The garage owner is looking to illuminate exit signs with LEDs on top of the walls and the ceiling. The garage owner is a Non-Playable Character (NPC) who hired the player to repair the exit signs. Regarding the story, they are the person the player is trying to satisfy, just like in a real-world scenario. They need this job done quickly because the town inspector is coming later that day, and they need the Exit Signs to pass inspection. The lights have different power sources and an LED; however, each circuit needs the correct resistors to prevent the LED from blowing up or lighting up. Due to supply chain issues, the player has only a few spare LEDs (as described above). If too many LEDs burn out, the job cannot be completed. The player carries many standard resistors to complete the job but must find the suitable resistors that work best or are good enough.

A player climbs the ladder to each of the different exit signs looking to complete circuits. Once they reach an exit sign, the player becomes the “mouse cursor.” Its primary task will be to place a correct resistor into the circuit.

LEDs are non-playing characters (NPCs). There is Ava, which is the first LED that Dragomir will discover in the first box (set like this, whatever box the player reaches first). Dragomir could decide whether to discuss and get to know Ava better or not. There are a couple of dialogs pre-set so Dragomir could explore what Ava knows (see figure 6 below). Some information is helpful but not all. The LED is scary and may exaggerate risks to play super safe. Dragomir will eventually discover this and learn that only some of what the LED says is entirely correct (like a teammate on a job that could be mistaken, too cautious or not enough, and trying to rush to complete work too quickly). The LED is also an NPC that will tell you the results of your selections. It will either illuminate, not illuminate, or blow up. The LEDs are a pseudo partner when completing the circuit. LEDs provide assessment feedback to the player.

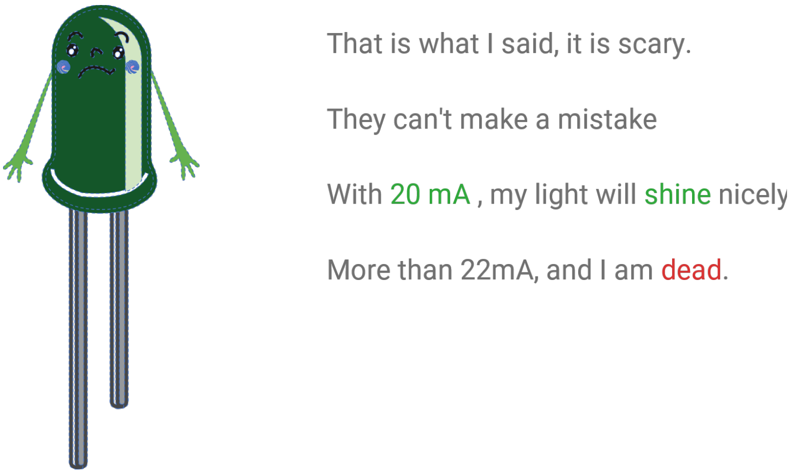
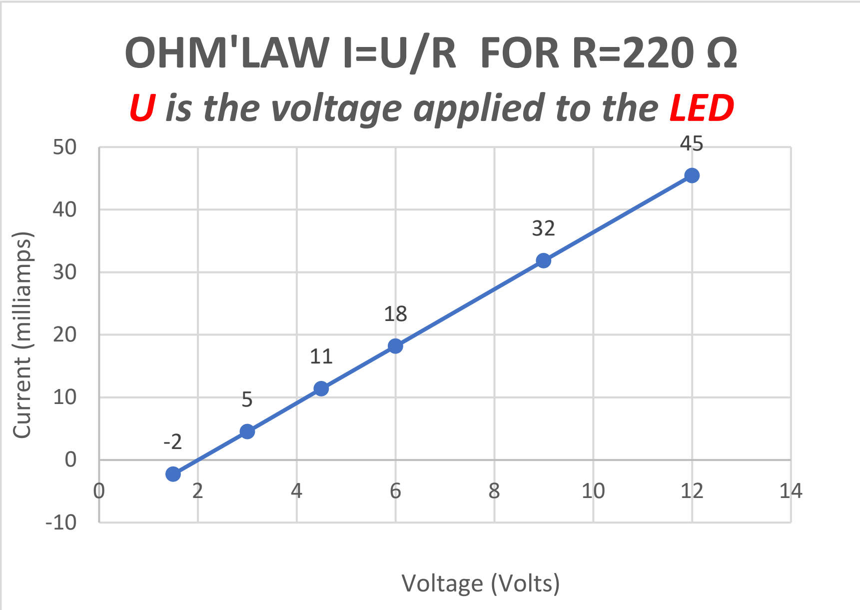


Figure 6: Dialog with the LED

Dragomir could also rely on a LED’s datasheet. However, it is a complex document to browse, and it might be challenging to find relevant information, depending on the manufacturer. Some datasheets are in a foreign language and have no translation (or the translation makes no sense).

In addition, Dragomir can use various tools to estimate values and solve problems. There is a current flow simulation to test a one-by-one resistor and determine the one best suited for the job. It will take a long time, the first try per puzzle is 10 seconds and then increases to 20 seconds and 30 seconds (the computer is getting slow), and the player will have nothing to wait and nothing to do. It is boring on purpose, and a loading/calculating animation is shown on the screen. A clever apprentice will eventually stop using this feature too much as it is a low-level way of solving the problem. The simulation can be used once to check a value in case of doubt. Other tools are more effective, such as using the buttons with formulas, test, and a graph representing the proportional relationship between current and voltage.

The graph (see Ohm’s law Graph below) is handy for someone to see how the current evolves given the voltage and the ultimate effective tool in most cases. The formulas are required to calculate the correct voltage value. Eventually, the player will discover that the battery voltage is one of many data that matters regarding voltage.



Graphs providing the current flow given the voltage provide visual representation of data and can support the learner's decision making. The graph is made with the LED in mind; therefore, the title of the graph is explicit of the voltage considered. It is very important aspect since there is a difference between the voltage provided by the battery and the voltage perceived by the LED. At some point the player will realize there is a discrepancy and has to investigate where the difference comes from. The formula is provided, and the player will have to link concepts together. Once a player has figured out the correct voltage to apply, the graph reads easily. For example, with a voltage of 6 volts and a resistance of 220 ohms, the current is 20 mA, the best brightness possible. The game will provide as many graphs as there are standard values of resistance available in the electrician bag.

The game comes a set of standard values of resistance available and the following 16 values for resistance. They are selected to provide best and good enough values for the range of battery voltage selected and is designed to provide enough choices but not too many that would make the choice too daunting.

56	68	75	82	91	100	160	220	330	390	470	560	680
750	820	910										

Batteries will be in the range 1.5V to 12 V and have different shapes to provide various visuals reflecting real world situations. There could be one battery or a set of 2 up to 3 wired together. Batteries will be in the range 1.5V to 12 V and have different shapes to provide various visuals reflecting real world situations. There could be one battery or a set of 2 up to 3 wired together.

Figure 7: Batteries

Figure 5 above with the circuit resistance placeholder shows how the player will select a resistor from an interactive list with visuals and values and then drag it into the circuit. Kapp explains that the game's story "provides relevance and meaning to the experience" (p. 41). For our game, if the player cannot perform the tasks, the garage will remain dark and LEDs could be damaged and not set up correctly. It directly relates to the learning objectives.

In addition, characters provide a somewhat thin story, but still relevant as LEDs experience emotions and want to feel useful by reaching their highest level of brightness, reminding the learner of their responsibility to improve their skills. The underlying story is also reflected in the name of the game using original names. Even though our game does not feature a complex storyline such as described by Kapp (2012), page 42, we have a couple of twists and surprises. Randomized pre-installed batteries make replaying the game differently

However, there is no storytelling like a lesson or virtual teaching. The player must discover tools, test/simulation, and estimate values on its own. No one tells him how to do the job except for feedback and counters providing what works and does not.

The game uses a story and characters in a pleasant realistic, and complex enough environment, but the text is mostly about guiding to get the player through. However, there are opportunities for the player to experience rising actions as they use tools. They will eventually figure out which ones work best (climax) and revisit all of them to use them when they are the most useful (falling action). For example, a player could start using the simulation tool and dialogs with the LEDs, then move to use formulas and graphs and increase its speed with a possible “ha-ha” moment. Then, they could go back to using the dialogs with a LED when a datasheet is not translated but use it with a grain of salt.

In the same way, in doubt, with a weird unique situation (like negative values mentioned later), the player could test one resistor value to check a hypothesis and lose only 10 seconds. As in any story, there is a conflict and resolution, but it is not directly visible. Players will grow awareness regarding the way they solve problems. They will experience the need to depart from basic trial and error testing as well as rushing into a solution. On the contrary, the game resolution will be that players benefit from structuring their decision path and using tools in the best way possible.

At first, we designed each puzzle as a level, and the player had to solve a puzzle to get to the next level. However, this structure implies working with difficulty levels and may not be satisfying for a player of an explorer’s type. In addition, we did not design the various puzzles with a progression in mind. At this stage, there are 12 puzzles, more or less of a similar difficulty level, with a couple presenting unique situations. These can be tackled in any order by the player. A player could abandon a box and move to another one if there is no resistance in the circuit. Otherwise, the game will prompt: “Validate the circuit with the resistor placed or remove it to cancel it.”

Gameplay – Core Loop

The player wanders in the garage and climbs a ladder to reach an “EXIT SIGN” electrical box. Players open the box and discover pre-installed components. Players use tools (simulation, formulas, Ohm Law’s graph, dialog, datasheet, standard resistance values) to figure out which resistor they want to insert. Then, the player makes a decision and adds a selected resistor in the placeholder, flips on a switch that closes the circuit breaker. The LED reacts and displays its brightness (as a percent). Further, the player must assess if they prefer to improve the resistor or move to the next box, considering the limited time to complete the garage job and the feedback provided by the LED and counters.

Core Dynamic

Looking into the list created by Boller & Kapp (2017), our game uses puzzles and problem-solving as core dynamics. The puzzle features drag-and-drop dynamics and a switch ON/OFF to get the counters to update and the player can receive feedback. Problem-solving is supported by five tool buttons that provide dialog information, simulation and test tool, Ohm’s graph, formulas, and datasheet.

Players win the game when they leverage the tools and better understand their usefulness, solve the problem, and complete the puzzle provided. These dynamics are directly related to the learning experience; however, walking, climbing the ladder, and opening boxes in the garage do not directly contribute to the learning experience but are part of the story and entertainment. Walking in any area provides a sense of freedom to the player.

Scoring, Reward, Assessment

The players are assessed when they are working on the circuit portion of the game. The LEDs' brightness and state provide feedback for completing tasks to a certain degree. The assessment of the learning objectives is formative as students receive instant feedback on their work and could improve from their mistakes.

When an LED does not work or burns out, the LED will tell the player the number of milliamps passing through, which will indicate what went wrong. For example, when the resistors do not supply enough resistance, and the LED burns out because of excessive current. When the LED does not light or barely illuminates, the resistors supply too much resistance, and the LED does not receive sufficient amps. Since LEDs work at 100% or less, the player will know that they selected an appropriate resistor and may tinker with it to improve the illumination percentage or decrease it if necessary.

Activities match learning outcomes as described in the learning objectives paragraph. There are four counters for scoring and measuring the degree of performance of the apprentice.

1. The number of puzzles solved with a good enough brightness level (80%)

Designing the LED brightness counter properly requires an understanding of circuit laws and how much current a LED can sustain and when this is optimized. The designer has to uncover all the intricacies to be able to provide the underlying calculations. For example, it is not sufficient to take into account the voltage of the battery, one has to know about the LED voltage and subtract both before applying Ohm's law. The process used to calculate the correct and incorrect values is clarified and all formula and graphs that are useful provided as tools to the player.

color scheme		COUNTER
	milliamps amps	Percent Brightness
burnt	30	150
too much	25	125
just over best	22	110
best brightness	20	100
good enough	16	80
quite not enough	15	75
not sufficient	10	50
no light	5	25

Figure 8: Counter Design for LED Brightness - in Percent

The light brightness counter (see figure 8 above) has a color scheme and feedback that will be given depending on the milli amps going through the LED.

2. The second counter game averages all values of percent brightness provided by each box Each box displays the brightness in percentage and with a light cone as shown in figure 3 (Top View of the garage). A computed dataset (figure 9 below) provides all solutions.

		Choice of Resistance (Ohm)														
Example validated		56	68	75	82	91	100	160	220	330	390	470	560	680	750	820
Green Red LEDs 5mr		current (milli amps)														
V_L = 2V	-1	-9	-7	-7	-6	-5	-5	-3	-2	-2	-1	-1	-1	-1	-1	-1
voltage applied	1	18	15	13	12	11	10	6	5	3	3	2	2	1	1	1
V_s-V_L	2.5	45	37	33	30	27	25	16	11	8	6	5	4	4	3	3
V_s battery voltage	4	71	59	53	49	44	40	25	18	12	10	9	7	6	5	5
	7	125	103	93	85	77	70	44	32	21	18	15	13	10	9	9
	10	179	147	133	122	110	100	63	45	30	26	21	18	15	13	12

Figure 9: dataset that will be used in the game

For example, with a battery of 9V a green LED having a 2V offset, the voltage to consider will be 9-2=7V and the current will be provided by the Ohm's formula of I=U/R. In table 5, it shows one of the optimal choices will be a resistor with 390 ohms producing 18 milliamps of current. There is also a second solution with a resistor of 330 producing 21 amps but this is not the preferred value as it is better not to go over 100%. The best solution provides a good lightness of 18/20. This is a 90% brightness fit**.** This example is validated at the design stage to make sure all data provided for the next stage of development have no design flaws.

3. A counter will show the time elapsed and the remaining time available. This will be shown with the other counters in the top view at the top of the screen, see figure above.
4. A fourth score is of interest to the player: Spare LEDs (Lives). Due to supply chain issues, players are given limited spare LEDs. They are enough to complete the circuits for a certain amount of "exit signs" while only having a certain number of LEDs. Anytime they burn an LED, it will be subtracted from their stock. The game is not over yet when there are no more LEDs in the stock because the player could manage to get an overall brightness of more than 80% and still win the game.

In this game, players do not earn points. Instead, they observe how counters evolve and try to improve their percentage value, see figure 3 with all counters calculated and shown in green at the top of the screen. The scoring motivates players because they can improve counters by applying a better resistance to a circuit. So, they will want to do better.

In addition to the counters above, there are "faulty" boxes that should be detected, as part of the learning experience, by the player. The 1.5V battery will create a unique case of "not working" with negative values (as shown in figure 5 above) that should be treated quickly by a player who understands an LED must have a positive current flowing so there is no resistance that could work. This special case will create a 0% rating for the box, which is expected but it will not impact the overall average if the player checks a box that identifies this box as "faulty".

The interface will provide a checkbox to identify "faulty" boxes that do not have the proper equipment to proceed. One box will have a broken LED, another with tangled wires and one box will have a 1.5V battery, all cannot work. This will provide 3 out of 10 opportunities for a twist in the game to prevent the game from becoming too repetitive and possibly boring. If the player selects the "faulty" checkbox for a box that was not identified as faulty in the design stage, the game will send a warning: "Are you sure? If this box is not faulty, there will be a zero percent fit applied that will negatively impact your overall performance". The player can uncheck a "faulty" box at any time during play, but they must walk again to the box, climb the ladder, open the box to access the checkbox. So, this is a waste of time if not done properly at first, reflecting real life concerns with expensive rework.

Finally, as players may run out of time, replay is encouraged until the player reaches the best award. Because the battery voltage is randomly set, and there are faulty boxes (randomly distributed) to create a fun twist, players will experience a different experience every time even thought it targets the same learning objectives.

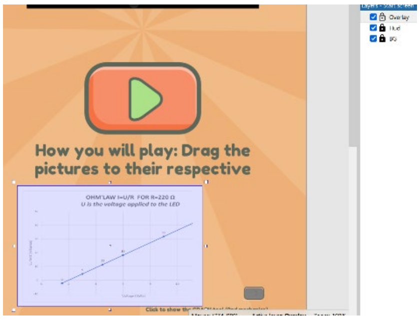
From the Evaluator Practice Activity the summary table below:

GAME mechanics	LOW ORDER	HIGH ORDER
electrical circuit with LED	identify, calculate, simulate	analyze best option to optimize solution
is present?	Yes, browse list of standard resistors, calculate voltage and current, simulate brightness	Yes select best standard resistor, decides which one to drag and drop into circuit

Justification	the player uses resistors available, operates the formula calculator and the simulator by providing inputs	the player analyses options and investigates the best course of action
SCORING counters	display output values	brightness LED in percent
REWARDS challenge	gets more info to analyze the circuit needs	GOOD or BEST solution at each level toward the best electrician award

Gee's Principles Addressed

This game addresses Gee's principles of learning in multiple ways. More specifically, it addresses the "Agent/co-design" principle, t, and the "Pleasantly Frustrating" principle.



According to Arena's (2014) article, 13 Learning Principles that Games can Teach Us, the Agent/co-design principle means "what you do matters, it affects the game" (p 1). This is addressed in the game through its mechanics and its scoring. The simple mechanics of dragging and dropping resistors into a circuit means that the player directly affects the game by the selections they make, and all affect the game. The game's scoring, where players earn points to complete the circuit, speed of completion, the overall level of light brightness of the garage, and losing a LED (life) if the player blows a LED in the circuit, are all affected by what the player does.

The game also addresses the "Pleasantly Frustrating" principle. According to Arena's (2014), the "Pleasantly Frustrating" principle means "the gamer feels a challenge that he/she knows can be overcome, keeping the challenge at the edge of the regime of competence" (p 1.). Due to the change variables for the set components of the circuit, and the different tools provided, the player explores how to work with information, graphs, formulas, and skills to complete this circuit. With limited resources, players must think of smart ways to make the circuit work, which leads to higher-order challenges that the player needs to overcome.

Construct 3 Game Implementation

Kay's URL: Tutorials and changes implemented

Because we needed a tutorial containing the mechanics we want to use, that is collecting, selecting, drag and drop... I started with this one: https://www.construct.net/en/tutorials/drag-drop-crafting-system-2639

I made it work, but it was quite raw. The author mentioned she was inspired by little alchemy, so I played this as well: https://littlealchemy.com/ In the end, I decided to use a Code Canyon game so the code would be closer to what I was looking for, a drag-and-drop effect with a special effect when the object is placed:

https://codecanyon.net/item/shadow-game-drag-and-drop/3674548

I also used the Beginner's guide to Construct 3. The guide was practical in explaining the basics of how construct manages the assets and how to set up events. I used this tutorial to customize the game start page, categories, and animations. I uploaded frames to change animals with my images of electrical circuit elements. The special effect and music are still working well. We can drag an element into its placeholder. I also modified a category so it now holds my circuit components: battery, a LED worried about what will happen, and a resistance. Due to time constraints, I was unable to move placeholders in a vertical grid to form a circuit puzzle.

I inserted in the itch.io game instructions to see how the mechanics are demonstrated. Since the prototype is not the game, I inserted the game's instructions in an Appendix.

In addition, I inserted scores in the win screen (adding one point for every successful drag and drop) and a new button to display as an overlay the graph tool in the start screen to demonstrate a second mechanics for the game when the player wants to access a graph tool.

Nick's URL: https://nicholasstrzelecki.itch.io/7384-level-4-game-exit-sign-levels
I made a partial game where a player (represented by a purple box at this moment), can move around and climb ladders to get to "exit signs". Once the player touches the "exit sign" they are teleported to the "exit sign circuit" where they will have to drag and drop the resistor (which I believe is your edited tutorial). Once they drag and drop the correct resistor and have tested it to see if it is correct, the player returns to the starting level where they can move to the next "exit sign". The only counter I have is the "Spare LED" counter. However, since I do not have a circuit to apply any behaviors or events on the event sheet, I can't really do anything with it.
1) Description of the tutorial you used (or template). (1 point) I did not edit or modify any tutorials. I was unable to open any tutorials on my computer. I used a bunch of YouTube tutorial lessons for the ideas and functions you saw in the game. The links for the tutorials are:
Construct 3 - Beginners Guide to Construct 3 Episodes 1-7
Construct 3 - How to make a simple ladder effect.
Construct 3: How to make a health bar.
All downloaded sprites came from this royalty free website. Please add this to the references.
https://www.kenney.nl/assets
How to get construct 3 game to itch.io
2) Description of the modifications you made to the tutorial/template. (1 point)

I started with making a basic layer for my game and then added a solid color background with a tile map for a hard surface for my player to move around. Then with the combination of royalty-free downloadable sprites and my own custom sprites, I created a player that can move around with the arrow keys regardless of touching the ladders or not. To do this, I set certain events in the event sheet to ignore 8 directional movement controls when touching the ladder and instead simulate platform controls.

Then, using ladder sprites, I created the scenario that we explained in the story for our game. The player is an electrician looking to complete circuits for LED "exit signs". To create the feeling of moving from one level to another, I set "exit signs" to the behavior of when the player overlaps an "exit sign" that would take the player to a different layout (another level). I did the same thing for the exit door to return to the start.

The final piece that I added to the game was a "spare LED" health bar. This was to represent the extra lives concept we mentioned in the game play. When a player is working with a circuit, they may mess up and put the wrong resistor which burns out the LED. When that happens, one of the spare LEDs would have been used and would have been reduced on the counter.

3) Your Construct 3 implementation will be assessed as follows. (8 points)
In regard to the scoring aspect of our game/ tutorial. Please refer to Kay's tutorial edit. I tried to add an element with scoring "the spare LED/ extra life counter" however, without circuits to manipulate, the counter would not change.

Appendix

GAME Instructions

Background

You take the role of Dragomir, an electrician apprentice. Your job is to complete the installation of Exit Sign boxes. There are 10 boxes, and you can decide how you do the work in any order. Each box contains a pre-installed battery, wires, and a placeholder for a resistor.

Goal

You must figure out which resistor is the best or a good enough fit to provide sufficient LED current.

Characters and Tools

LEDs are fancy little things that can talk and feel emotions. There is Ava and her friends. You could engage in dialogs with them to learn what they know and how they can help. There are also scientific tools like simulation, graphs, and formulas tools that can help you. Use the help to think long and hard before making a decision, as the time of rework and going back to a box will jeopardize your performance.

Feedback

Once you have selected a resistor, you will drag and drop it in the placeholder and close the circuit switch. You will receive instant feedback with a percentage of brightness the LED has reached.

Strategize

You may try to improve or move on to the next box. It is all about strategy because there is an overall time constraint of 60 minutes, about 5 minutes per box, and 10 minutes lag time. The customer expects this to be a one-hour job, so you are under lots of pressure to perform.

Win the game - Awards

If you reach 80% of the overall brightness in the garage, you win the “good electrician” award. However, if you get 90% or more, you will celebrate the “great electrician award” and receive an extra surprise revealed in a dark corner of the garage.

Do your best effort. Re-play as needed to get more skilled with circuits with a LED and score high in the global leaderboard. Good luck!

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