Level 2 | Develop a Games Research Report (Beat the Boss!)

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The Method

Search and Selection

My search began toward physics curriculum principles and learning simulation activities. I looked for “motion simulation game, speed, time, acceleration,” and other related keywords. I was able to find several simulations that would fit the target audience of middle to high schools’ level, for which the concepts of acceleration, speed, and distance vs. time are introduced. Physics teachers, universities, and nonprofit sites offered simulations with various interactions and visuals to address the pedagogical aspects.

Then, I looked for games about speed vs. time or motion characteristics. To conduct my game search, I used internet search engines as well as visited references sites suggested in our course:

- https://store.steampowered.com/
- https://www.epicgames.com/store/en-US/
- http://www.gamesforchange.org/games/
- https://itch.io/
- https://tabletopia.com/
- https://en.boardgamearena.com/

This search brought games with a similar genre, such as trains, trucks, car racing, and so on. I selected a train game since it was likely a straighter path, fewer turns, and more intersection challenges. I was genuinely impressed with the immersive experience they offered. There was an acceleration counter of sorts and sophisticated use of various types of brakes. These mechanics can impact the movement’s acceleration directly, so this was an exciting find.

In addition, I found the ski resort sim building (Snowtopia). They had developed a great setting with a low poly environment and 3D models, the kind I could create for an indie budget. It also featured powerful and elegant mechanics that let you create an entire ski lift and service building by clicking a few points, like vector graphics and a Bezier curve. Quite an inspiring and original set of mechanics.

Then, I looked for civil engineering games and light traffic synchronization strategy games. I found interesting informational videos analyzing the problem and how engineers and traffic signals provided an effective solution. Also, I found the space engineer's game. I liked it, and I realized it won quite a few awards, but, in the end, I did not select it as it seemed too sophisticated and too much work to be inspiring. These findings informed my search process.

Toward the end, I realized my search had been oriented toward physics and civil engineering topics, and maybe there were other kinds of city builders to look for. The genre brings strategy into the mix, and this is inspiring for my game. I found and wondered if the famous sim city game could have parts related to my topic. I read this excellent article: https://www.simcityplanningguide.com/2013/11/simcity-civil-engineers-perspective.html. Then I looked at some videos that give tips and tricks on planning roads, traffic, and intersections with sim city. I learned the most from this one: https://www.youtube.com/watch?v=g-8lhpINmXE. Finally, I added the sim city "build it" version to my list so I can continue exploring it later.

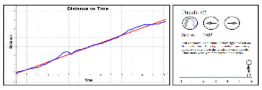
Overall, the selection process was challenging because the way the subject matter is addressed in educational settings as part of a Physics school curriculum needs to be more connected to the real world. A physics teacher isolates the concepts when introducing motion characteristics such as speed vs. time graphs, acceleration, distance, and time considerations. Typically, only a car, a ball, a stickman, or another object is moving. These simulations provided a good understanding of the targeted learning objectives but could have been more fun. There were two simulation games, though, although aesthetically minimalist, that provided interesting ideas of mechanics. One required to move a stickman so its speed would align with a given Speed vs. Time graph. It involved physical dexterity and trial and error, and I could learn quickly how the stickman motion related to its graph. The other had two buttons to guide a car allowing a player to increase and lower speed. These mechanics connected well with a real-world experience.

On the other hand, once I started looking at game resources, the subject matter was not isolated, and it was not easy to know if anything about it was hidden there. Many games use motion and physics, but it is difficult to know if the players will have any chance to learn anything related to these topics. I selected the games that displayed on-screen physics data, maps, and graphs, hoping the presence of such quantitative data reflected some kind of simulation engine within. If physics principles were appropriately leveraged, I could use some of their ideas to design my game further. That is how I selected the train game.

Due to time constraints, the selection process was performed with a mix of left and right brain effort. It might be interesting to reiterate this search later in the process once the game design is more precise. I could use slightly different keywords to guide the search and make different selections that match design needs differently.

The Results

Game 1: Move a Stickman Puzzle by David Wees



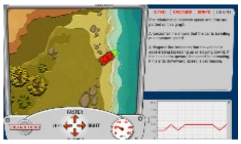
SIM GAME Move a Stickman Puzzle

- **URL**: http://davidwees.com/graphgame/
- **Learning Domain**: The game covers conceptual knowledge related to speed, distance, and time. A learner is experiencing the concepts of motion and speed first-hand. The slope of the line on the graph represents the relationship between distance and time.
- **Core Dynamic**: The player can move the stickman and observe in real-time the kind of line the motion creates in the distance vs. time graph as the slope of the line evolves. The score increases as you get closer to the line provided. The visual feedback is immediate. It is a safe environment to experiment with as we can replay indefinitely.

- **Short summary:** The game offers 12 puzzles with increasing difficulty. Level 1 requires the player to know how to read a distance from the graph and understand that a stickman with no motion (speed=0) will match the curve. It does not work well, but we can learn the effect of the motion on the curve. Level 1 is the most effective in demonstrating the relationship between speed, distance, and time. The other levels explore various slopes.
- **Explain Objectives and Goals:** There is a score displayed that increases when your stickman's trace gets closer to the given line. Not sure how this is calculated. Probably inversely proportional to the distance to the curve.
- **Comparison with the project's topic:** This simulation contains a topic about our game design and a matching dynamic with a given line that is motivating. Could these short simulation mechanics be sufficient for a learner to understand that speed equals the ratio of distance to time? Probably not. Some prerequisite facts would be needed. In addition, a story and a realistic context could help as well. These would help the learner master basic facts (Kapp, 2012, chapter 8).

Game 2: Control Your Car by PBS learning.

- **URL:** https://contrib.pbslearningmedia.org/WGBH/conv20/phy03-int-accel/index.html
- **Learning Domain:** Some factual knowledge with definitions and explanations is introduced in a written text. Concepts related to the relationship between speed and time, acceleration and speed, and vector representations. There are also some basic notions about a car's direction. The simulation attempts to deliver some rules: a diagonal line indicates the vehicle is accelerating.



SIM: Control your car

- **Core Dynamic:** The user can press different arrows to control the car. There are four arrows: faster, slower, right, and left. The car can go anywhere, but I got stuck along an ocean line. I could observe the display of vector arrows of various colors. There is a real-time display of the Speed vs. Time graph with units of seconds for the time. There is also a speedometer showing MPH. You can stop the car by decreasing the speed.

- **Short summary:** The simulation guides learners to experience how a faster or slower command translates into a car motion, its speed vs. time graph. Learners can also visualize some directional vectors (velocity, acceleration) and related information.
- **Explain Objectives and Goals:** Learners can experience first-hand the effect of a change of speed (faster, slower) and a change in direction to a car's motion. They can visualize vectors and graphs in real time. As per Kapp (2012, chapter 8), learners can tackle rules learning only after they have acquired facts and understood related concepts. I do not believe this sim can provide enough play for such a steep learning curve, so I expect learners to feel lost with the highest learning objectives.
- **Comparison with the project's topic:** The simulation contains facts and concepts of interest aligned with my project. However, this also differs from the way I would introduce the terminology. My students will probably dismiss lengthy texts. In addition, facts are mixed with information on how to play the game. Directional vectors are difficult to visualize since they only exist when the car moves. There is a need for a "pause" to take a snapshot.

Game 3: Traffic Command by friv2online

- **URL:** https://www.friv2online.com/trafficcommand.html

GAME: Traffic Command

- **Learning Domain:** The game tackles concepts related to the automation of traffic lights at an intersection. As they experience concepts, players also learn how to create sensible rules that optimize traffic flow and prevent poor outcomes, such as brutal accidents and frustrated, angry drivers. As per Kapp's classification (2012, chapter 8), the game addresses conceptual and rules-based knowledge domains.

- **Core Dynamic:** The players can click on a traffic light, making it green or red as they see fit. The players experience the consequences of their choices as they can earn points ($) when they succeed or fail. A failure is penalizing and happens when a bad event occurs, like an accident or an angry driver's road rage.
- **Short summary:** Levels are increasing in difficulty, and players learn to sync lights as they go. However, there need to be more measurements of time, distance, speed, or acceleration, and science is not involved making it primarily a trial-and-error experiment.
- **Explain Objectives and Goals:** It is difficult to determine the end goal, as finishing the game or experiencing many levels is quite tricky and time-consuming due to constant advertising interruptions. There is no save and load the game feature. Overall, the objectives seemed to open green lights to get a load of cars to go through and alternate quickly back to red to stop any accidents. We learn how complex this can become.
- **Comparison with the project's topic:** This game contains many facts, concepts, and rules the players will experience in my game. However, the dynamic of clicking on traffic lights and the absence of scientific data and graphs place it further away. Indeed, my project strongly focuses on learning science as per the physics curriculum and applying them in real-world settings. Therefore, the link between theory and application has to be part of the player experience, which is missing here.

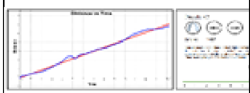
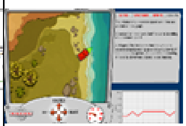
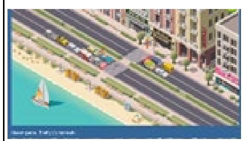
The critique

Type of Play

Macklin and Sharp (2016) examined games and created categories for the kinds of play they included. I summarized these categories and their meanings in the table below. I also used a simple rating system to show how the games/simulations I selected for this report are categorized. I used a 3-star rating (***) when the game uses more than 90% of this kind of play. For example, the traffic command game's goal is that we learn skills on how to optimize traffic flow, so it is, at its core, a "skill-based" game.

Between 60% and 90%, I inserted a 2-star rating. For example, The game "control your car" empowers the player to learn how to stop by decreasing speed. It also immerses the player in an experience where they can drive their car around. However, the core play of the simulation is to visualize directional arrows and graph patterns, not gameplay.

Then, I used a 1-star rating of around 40% (+/-20%). For example, the "control your car" has a little uncertainty and absurd moments since we can drive anywhere not knowing what we are doing. Finally, I used no rating below 20% (rare or no occurrence). All my games have no competitive, cooperative, role-play, performative, or expressive kind of play.

	Key elements to look for in the game	 SIM GAME Move a Stickman Puzzle	 SIM: Control your car	 GAME: Traffic Command
Competitive	Winners and losers?			
Cooperative	Players Work together?			
Skill-based	Players develop skills?	***	**	***
Experience-based	Story? Explore?	*	**	**
Chance and Uncertainty	Unpredictable moments?	**	*	**
Whimsical/magical	Absurd? Euphoria? Silly?		*	
Role-play	Storytelling? Rule and possibilities?			
Performative	Theatrical? Improvisation acting?			
Expressive	Human experience?			
Simulation-based	Models real world? Personal perspective?	*	**	***

Play Matrix

As per Fullerton (2000, p. 299), the "horizontal axis is a continuum between skill and chance", and "the vertical axis is a continuum between mental calculations and physical dexterity". I tried to place games and simulations on a continuum, comparing each other. I wonder if there was another item that could affect shifting things.

I found it challenging to classify simulations since there is no win/loss state, and it is hard to determine the chance/skill balance. Chance is involved in starting with then you can learn a skill and create different situations. First, you input some initial parameters and then look at what is happening. Moving a stickman is a sim game giving visual feedback and a score when your guesses get better, so I placed it closer to the skill side since it makes you acquire skills to win. The physical simulation with Arduino has no factor chance involved since you follow a given construction plan to build it. There was no play, just reproducing the real thing.

Because my physical dexterity is not the best, and most commercial games require it, I just had to place there the games I find challenging (I must watch videos to see how it plays). The exception was the "traffic command" game that required no physical dexterity. It was fun and easy to play, click on traffic lights, and think of ways to avoid accidents and angry drivers.

Given these considerations, I placed my three games on the matrix below. I added a fourth game (the Train Sim World found on Steam) that I did not detail here, but it is also interesting as it explores the physical dexterity and skill quadrant and helps position the other three games/simulations.

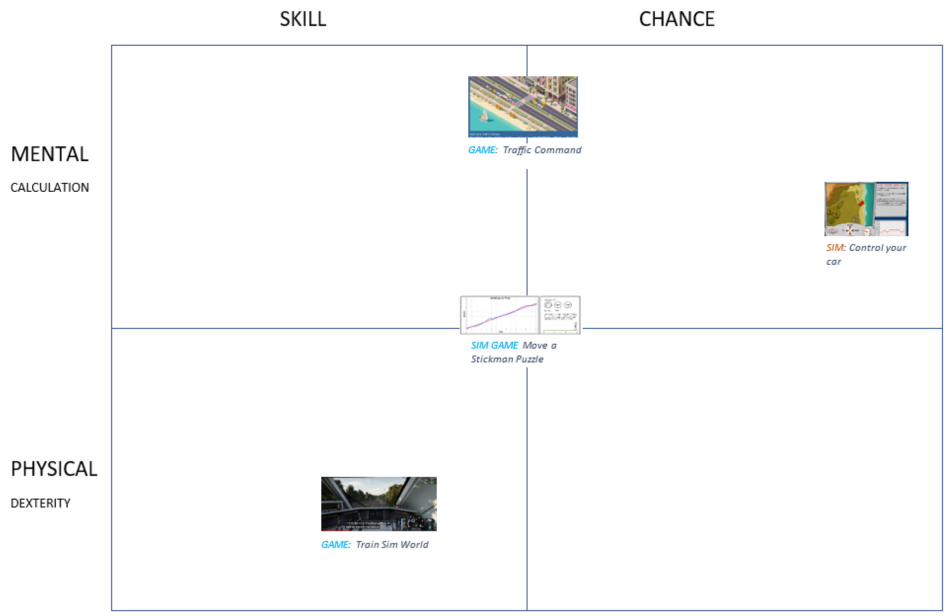


Figure 1: play Matrix

Discussing quality of findings

A finding will be a good one if it meets the needs of our market research at this first phase of design. Considering there is little known about the future game besides the subject matter and the learning problem, findings could give us ideas about how others have focused their efforts and what learning objectives and game mechanics they worked with. There may be some innovative features I could think of and possibly invent that I have yet to see being used.

The findings responded to what I intended but surprised me as I had not seen all aspects of the topic at first. Wearing my engineer and physics teacher's hat led me to find simulations and games developed with this perspective. However, taking a broader approach with my new game designer's goggles, I could see other perspectives on the topic and how they were treated. For example, including the feelings of drivers waiting at an intersection, success is only possible if they do not get awfully frustrated. The way the lights get on and off must appear fair to road users.

At this stage, I see a gap between learning simulation interactions and gameplay, as only a few findings could partially reconcile and bridge this gap. That is where research can help guide my design, providing gamification techniques that match the knowledge I would like my learners to acquire.

My game will start at the lowest level with basic facts and help learners master physics terminology. Then, they will connect them together to understand better the relationship between speed and distance, acceleration, and speed. As per the games I found, there will also have to be some considerations about vehicle flow and traffic signals design to investigate further.

Kapp (2012, chapter 8) suggested “matching and sorting” as techniques that can transfer well from the procedural to the conceptual level. Therefore, I will examine these and how they can work for my project. I might have to revisit the market research later as the game design progresses to see if I missed some games out there that could expose mechanics of interest with learning domains similar to mine.

REFERENCES

Fullerton, T. (2018*). Game Design Workshop: A Playcentric Approach to Creating Innovative Games*, *Fourth Edition (4th ed.).* A K Peters/CRC Press. https://doi.org/10.1201/b22309

Kapp, K.M. (2012). Chapter 8 – 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.

Macklin, C. & Sharp, J. (2016). Chapter 3 The Kinds of Play. *In Games, Design and Play: A Detailed Approach to Iterative Game Design* (pp. 47-76). Addison-Wesley.