IL315

Serious Game Design Essay

Pass Words Design Essay: Designing a Game to teach the Basics of Encryption

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1 Overview

Pass Words is a competitive print and play party game designed to teach encryption fundamentals in a classroom environment. Players on Team Alice will attempt to communicate with Team Bob without their messages being decoded by the interceptors on Team Eve. As a Print and Play game, Pass Words is easily accessible to anyone who would like to try it. The game is also made incredibly streamlined and easy to parse with an abstract and simple aesthetic. The game is designed to reward out-of-the-box thinking and a good understanding of the basics of encryption, as players who innovate new strategies will stay ahead of the competition. The party game nature keeps the fun light-hearted, while still promoting competition to motivate players[COO15, p 40] without causing emotional stress.

2 Learning Objectives

Modern Encryption is a mathematically technical problem. As such, I intially struggled to narrow down what would be teachable through a tabletop game. As I thought through my initial concepts, I discovered that it would be most effective to teach the fundamentals of encryption. These computer science concepts translate well into a game format[Hak11, p 87], as the game can add context and experience without without requiring technical mathematical knowledge. From this, I narrowed down the important concepts to understand before looking at the mathematics behind modern encryption.

1. Understand and apply common hand encryption methods (Caesar, Pigpen)
2. Create or modify methods to encode messages.
3. Evaluate and analyse different encoding methods and their weaknesses (Lack of Padding, Character Frequency)
4. Recognise and apply how a secret 'key' can be used to encrypt data from unauthorized parties.
5. Illustrate how and why modern encryption is secure.

With these goals in mind (based on [Bue21]), I began designing the core mechanics.

3 Mechanic design

Many classes on encryption often start using a hand encryption method such as a Caeser Shift[Bue21, p 12]. This is useful as the act of applying an encryption method requires the student to understand the method and then teaches it through its use [1]. This is the application layer of Bloom's taxonomy[EB25, p 169] and is the most important part to include in the game. So, I want a mechanic that rewards players who can understand and apply encryption methods. Another way to learn this is through [2], [3]. As players strategize and choose to use different methods of encryption and alter the standard methods they will be creating and evaluating hand encryption methods. So, I need to reward

gameplay wherein the encryption gets harder as the game progresses. This satisfies the higher levels of the cognitive domain of Bloom's Taxonomy: Synthesis and Evaluation

Another part of [3] is how players understand the flaws of different encryption methods. So, players must attempt to decrypt messages without the key.

From here, I decided on a competitive style game where players will attempt to send messages intending to be decrypted by certain players. This allows players to practice using common hand-encryption methods and experimentation to make new strategies. This strategic gameplay makes players consider their different options and think critically about the tools at their disposal. Players will naturally come across the concepts of padding and letter frequency; this emergent gameplay can create unique learning experiences that are highly effective[KA09, p 210].

As this was a competitive gameplay loop and was aiming at a younger audience due to my game being about the fundamentals of the concept, I wanted a mechanic to dissolve any emotional stress caused by the game. A way to do this would be to have changing teams between rounds as players cannot build resentment as opposing players swap into friendly players. This also has the benefit of letting players have different objectives each round (encrypting, decrypting, cracking), as the game is asymmetric[Gon+21, p 12].

[4] requires players to be able to share a key before they have to encrypt communication. One way of achieving this is through players' prior knowledge. As this game is designed to be played in groups, if players knew one another, they could use prior knowledge of their own interests and references to communicate privately. This idea is an integral part of Encryption history as the first methods relied on knowledge rather than mathematics. Another way this could be solved is through the player shuffling system mentioned earlier. Players could communicate and plan before swapping teams, so they have a strategy going into the next round. I would not want to explicitly state this in the rules, however, as secret keys are a part of why encryption is secure against unauthorized parties[Bue21, p 7] and so would be a very dominant strategy in the game. This leads into [5], as players improve the Encryption team should begin to win many of the later rounds. This can be helpful to illustrate how the encryption works in context with the real world. This will not be a balance issue however, as even though the game is asymmetrical, the players will have the same opportunities as they swap between the teams.

4 Aesthetic Design

As the game is very general, I wanted to keep the aesthetic abstract but referencing common encryption language where possible to add context. To keep the game print and play, I required most of the game pieces to be able to be made easily from paper and in black and white. This led me to the idea of using random knick-knacks and objects as game pieces. This allows players to have a lot of information to describe in their encrypted communications without needing to print excessively. I did add optional tokens in case players did not have the required parts. This print and play style keeps the game accessible and modifiable so players learn easyily.

5 Design challenges and Prototypes

In my first prototype, Team Alice and Bob would send multiple messages in one round. In practice, this led to lots of waiting time where players were not engaged. This could have caused players to disengage from the content. In my final draft Team Alice sends one message and then after 3 minutes, Team Bob and Team Eve must make their guesses. This shorter window allows players on Team Alice to share knowledge and plan for later rounds and give them a small break before their gameplay continues. Shorter windows like this are more conducive to learning as the player can rest cognitively without fully disengaging[AGM18, p 7].

6 Playtesting and Polishing

In one of my playtesting phases, I was testing with Team Alice writing two messages with one randomly going to the other teams. While this removed the copying section from Team Eve, this negatively affected the game as often, one note would be more eligible than the other. It also did not effectively represent how a malicious group intercepts communications..

In playtesting, I also ideated on my rule book so that it was easier to follow for new players.

7 Final design Evaluation

Pass Words is a great starting point to get students excited for classes on encryption. While the content is basic, the game offers good foundation for learning that helps get all students on the same page before looking deeper at the mathematical side of computer encryption. The game works effectively in large groups like classrooms and has a clear role for an educator to play as the Game Master.

The game is very accessible as a combination of print and play and simple rules allow for easy modifications. I would have liked to design a version that did not require players to get up to check the board. This physical limitation may not be accessible to some players and can also cause players to lose focus and disengage[AGM18, p 7].

8 Future developments

While I included 3 optional rules, the game would benefit from more optional gameplay to keep it fresh or teach other parts of the basics of encryption. The game would also likely benefit from a lesson plan that includes Pass Words as a section since some of the content input is required by the Game Master. Despite this being covered in the rules, a bespoke lesson plan may be more effective at delivering the content needed for students to get the most out of Pass Words. A digital version of the game with either a pseudo-code or python code editor could also be developed to test students' skills with more advanced mathematical concepts like RSA. The game would have to be largely changed as Team Alice and Bob would would have a larger advantage in a digital format.

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