CYBER ATTACK

Cyber Attack!
A Story-driven Educational Hacking Game

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ABSTRACT

There is an urgent need for cybersecurity professionals as large-scale data breaches and hacks are becoming daily occurrences. However, several perceived barriers prevent the young generation from pursuing a cybersecurity-related career. One of the major barriers is the perception that cybersecurity is a purely technical field that requires expertise in computer science. Attracting young people to join the cybersecurity workforce requires innovative pedagogical methods that go beyond the traditional cybersecurity education, especially to make the field more accessible. We postulate that game-based learning can motivate young generations to learn more about cybersecurity and reduce the perceived barriers that prevent them from considering cybersecurity-related career paths. To pursue this thesis, we developed Cyber Attack, a story-driven cybersecurity video game that incorporates various gamification elements that focus on fundamental cybersecurity concepts. This paper details the design principles we followed for the early version of Cyber Attack.

INTRODUCTION

Traditional teaching methods often fail to motivate and engage students, especially for the subjects in science, technology, engineering and math (STEM) disciplines (Helms et al., 2015). STEM learners first need to be motivated by understanding the value of these subjects before investing their time and effort in learning them. Using game-design elements in non-game system contexts, gamification can increase users' motivations, engage them in the learning materials, and help process information easier, thus leads to achievement of learning goals (Treiblmaier, Putz, & Lowry, 2018).

Gamified systems provide a method to design educational programs that is particularly effective in enhancing students' motivation in learning tasks and materials that are perceived difficult (Hanus & Fox, 2015). Gamification has been effective in increasing engagement and learning new problem-solving skills in diverse fields, including marketing, healthcare, education, and security training (Hamari et al., 2014; Osatuyi et al., 2018). Use of gamification is one of the suggested techniques to increase engagement and improve learning outcomes in teaching cybersecurity as well (Olano et al., 2014).
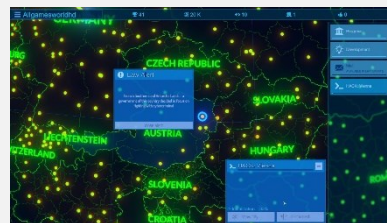
METHOD

We have followed a design science research approach to develop Cyber Attack! In artifact creation, we followed an iterative design process based on Helms et al. (2015)'s taxonomy of game elements (Table 1).
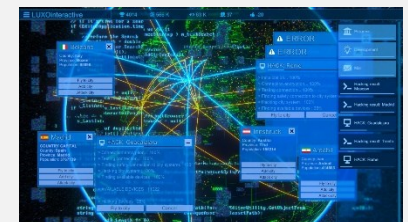
Table 1. Game Elements in Cyber Attack

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Progression	Quests	Players follow non-linear sequence of quests to progress through the game. At the end of each quest, they are asked to make a decision (see Figure 3).
	Storyline	The game includes a non-linear storyline that offers various decisions points. The story develops based on the decisions the player makes at the end of each quest. The decisions affect the player's *ethics level*, which is an indication of white hat or black hat hacker.
Rewards	Progression points	Each quest rewards the hacker with cumulative *progression points*, which give the ability to unlock new hacking skills.
	Resources	Each quest also rewards the hacker with *cryptocurrency*, *fame*, and *followers*. Based on her performance, the hacker also collects *personal data* during the quest, which she can sell in black market for additional cryptocurrency.
Rules	General rules	Cyber Attack includes basic rules to guide players and constrain their behaviors within the game.
	Time constraints	Each quest has a limited time. The more system the player hacks during this time, the more progression points and resources she earns.
Competition	Leaderboards	The leaderboard compares the achievements and progression points of all the Cyber Attack players.
	Challenge	In addition to the time constraint, each quest includes firewalls that slow down the hacking attempts of the player. Player needs to avoid going through areas with firewall (see Figure 5).
General	Control	Participants have control over how the game develops. The decisions the player makes changes her ethics level, which ranges between -100 and 100. For example, negative values attract more attention from the police.
	Fun	The game aims to be fun to reduce the effort players put into learning.

Cyber Attack is a story-driven hacking game in which the player controls a team of hackers.

An example of a quest with time constraint and challenges in which the player tries to hack as many devices as possible.

Players have control how the story develops by choosing their quests and deciding how to use their resources.

Using an interactive world map, the player can choose a quest in over seven thousand cities.

The decisions players make at the end of each quest affect their ethics level and the rewards she earns.
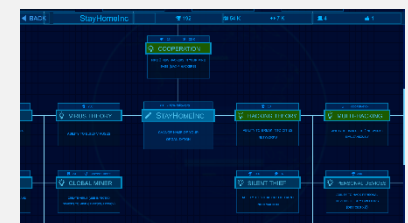
A part of the hacking skill tree where the players unlock more advanced skills as they progress in the game