Firewall Network Security Education Game

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***Abstract*—Network security is becoming an increasingly important subject taught in college courses. By converting this information into a game, it becomes less intimidating and easier for students pick up the material. This game will explore the effectiveness of an educational game about the purpose and how firewalls work.**

***Index Terms*—educational game, network security, firewall**

I. Introduction

A lot of the current network security games is directed towards young children to protect their identity and to encourage safe practices. I wanted to create a game that would be more directed towards college students interested in a more in depth understanding of network security. Therefore, I wanted this game to have higher level concepts taught in this course, such as as buffer overflow, worms, and bots. In the end, this game strictly focuses on the concept of the firewall, what it is and how it works.

II. Previous Work

Much of the previous work in cyber security educational are more geared to young children and encourage safe online practices, such as not putting out their name or age. Both CynjaSpace cyber security game app and McAfee's cyber security [2] follows this concept. CynjaSpace teaches safety practices using ISACA's cyber security guidelines. While McAfee focuses more on the importance of strong passwords as their game revolves on sending the player on a mission to secure documents using a multifactor authentication. For higher level cyber security concepts, there is a game created by Texas A&M IT Department [4]. It is more of a Q and A structured "game" concerning with safety measures university students should follow. Lastly PBS NOVA created a resource management game, where players must get resources to strengthen their network security and thwart attackers.

III. Goals for the Game

Before creating the game, there should be goals set aside that this game should accomplish. Goals as a game that would make it an effective educational game and Learning Objects that players should meet after player the game.

A. Effective Game Goals

There five main goals an educational game must reach for it to be effective. If the game reaches these goals, it will be a balance between educational and entertaining. [2]

- Include details- There should be enough information for the player to be equipped to choose the right action among many. The game should also give enough time for the player to process the information and then to proceed on to the game.
- Have appropriate context- The gaming environment needs to capture the cues from the actual work environment of the learners to help them make the suitable connection between the environment of the game and the work environment.
- Balance between instruction and entertainment
- Adequate feedback- The game needs to provide immediate and continuous feedback to encourage the feeling of satisfaction of their performance with the player.
- Appropriate challenging levels

B. Learning Objectives

The player should meet or go beyond these learning objectives after completing the game.

- Understand what a packet is
- Understand the purpose of the Firewall
- How it works as a security measure to the computer
- Understand what information on the packet is the Firewall looking for in particular
- Understand the different checks are required for packets with existing or new connections
- Understand the gateway concept

IV. Game Design

The main game design throughout the game is the player acting as a firewall. Before each level, there will be an informative screen that will educate the player on concepts and instructions for the level. In each level, the player will sort through the good packets and the bad packets. Allowing the good packets thru and disposing the bad packets by dragging and dropping it into the furnace. As each packet comes down vertically across the screen, the player must determine if it should be disposed before it reaches the bottom of the screen. Each level builds upon the level previous. There are three levels: Packet Filtering, Session Filtering, and Gateway.

A. Level 1: Packet Filtering

The player will filter the packets using the given IP address and port number.

Fig. 1. Screenshot of level 1 of packet filtering.

B. Level 2: Session Filtering

The player will filter the packets by determining if they pass certain checks. If it is a new connection, they must drag the packet to the security policy check and the packet will change color, red or green, good or bad. If it is an existing connection they must check with both the update table and state table.

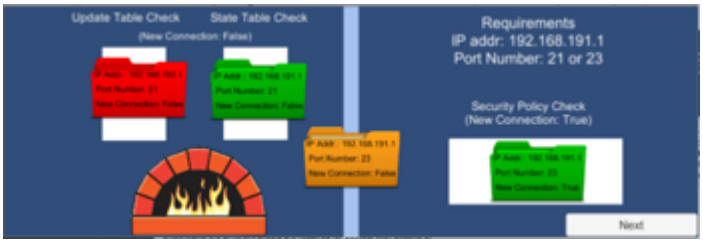

Fig. 2. Screenshot of level 2 of session filtering.

C. Level 3: Gateway

The player will check for outgoing packets and check with a given IP address.

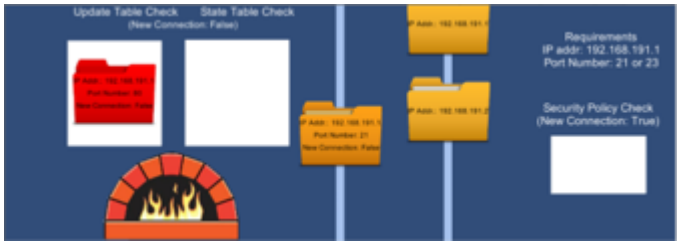

Fig. 3. Screenshot of level 3 of gateway.

V. Results

A. Pre Survey

Before having a two groups of 30 college students, 30 non computer science engineering students and 30 engineering students, play the game, we asked them to complete a presurvey to better understand their current knowledge level on the material and any previous course work in network security.

Fig. 4. In response to "Have you taken a course in cybersecurity?"

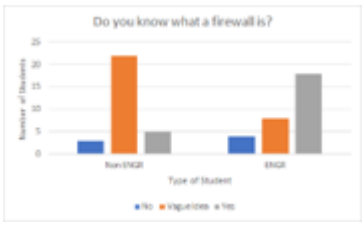

Fig. 5. In response to "Do you know what a firewall is?"

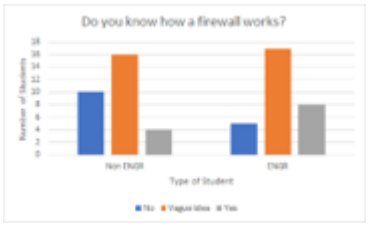

Fig. 6. In response to "Do you know how a firewall works?

Looking at the results most students have had little to no experience in a network security course. In addition, we wanted to see their current level of knowledge specifically on the firewall concept. Most had an idea and knew what it was, but majority have little idea how the firewall works.

B. Post Survey

After playing the game, each student was given a post survey to see how effective the game was in educating them and if they reached all the learning objectives. In addition to we wanted to see how entertaining they found the game.

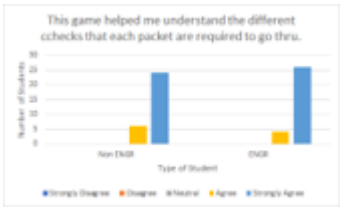

Fig. 7. Learning Objective: Understand the different checks that each packet are required to go thru.

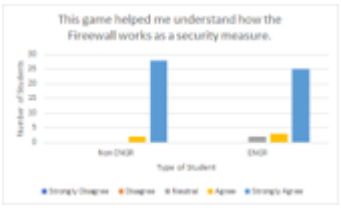

Fig. 8. Learning Objective: Understand how the Firewall works as a security measure.

Fig. 9. Learning Objective: Understand the purpose of the Firewall.

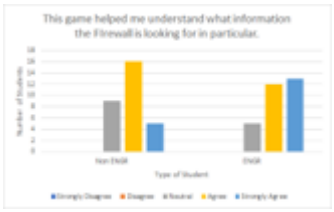

Fig. 10. Learning Objective: Understand what information the Firewall is looking for in particular.

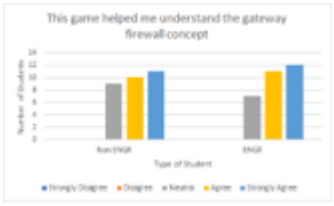

Fig. 11. Learning Objective: Understand the gateway firewall concept.

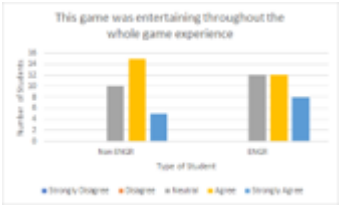

Fig. 12. Entertainment level of the game.

From these results, there is clearly trend of learning between all the students. But it seems like a clearer explanation or a tweak in the gameplay in the gateway level could be made to improve the understanding.

VI. Improvements

After receiving feedback from my classmates and the user study, I decided to improve the graphics and add more information pertaining to Packets and a better description on how the Gateway works. To counter the problem of the player not receiving enough time to make decisions, I decided to slow down the speed of the packets. I considered changing the game mechanic of the mouse click and drag, but after testing the game using keyboard controls, many of the players thought the mouse click and drag was more engaging and entertaining.

VII. Future Developments

In the future, I hope to add more games surrounding other cyber security topics, such as buffer overflow, viruses, worms, bots, phishing. And with a more complete game I would like to introduce this game to cyber security classes as a new way to teach students basic cyber security concepts.

References

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