

# Blue and Red team quiz game to train high school students

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## Abstract

In the ever-evolving landscape of cybersecurity, human factors play a pivotal role in determining system vulnerabilities. This article introduces *CyberDuel*, a serious game designed to educate high school students on cybersecurity through an interactive card-based gameplay. Drawing inspiration from the inherent human inclination towards play, *CyberDuel* engages users in defending against cyber threats while fostering awareness and decision-making skills. The game's design offers a non-threatening environment for users to experiment with cybersecurity scenarios. Through a detailed planning and design process, *CyberDuel* integrates elements to create an immersive educational experience. A user study employing the *GAMEX* test demonstrates the game's effectiveness in enhancing cognitive skills and learning outcomes. *CyberDuel* represents a promising approach to cybersecurity education, with the possibility of future development and refinement.

## Keywords

Cybersecurity, Serious Games, Cybergames,

## 1. Introduction

In the cybersecurity landscape, the human factor stands out as a crucial determinant of system vulnerabilities, often overshadowing the effectiveness of technical defenses alone. Human errors, such as lack of awareness, negligence in adopting secure practices and falling into social engineering traps, can be significant openings for cyber attacks [1] [2] [3] [4]. Consequently, in addition to investments in cutting-edge technology solutions, it is critical to place an emphasis on educating end users about cybersecurity. However, effectively raising awareness of cybersecurity among individuals is a significant challenge, requiring the implementation of appropriate educational strategies.

One of the highly effective is *game-based learning*, which allows people to experiment in nonthreatening scenarios and acquire knowledge through practice and social interaction both with the environment and their peers [5].

Games have long been studied by experts across various disciplines, leading to the emergence of the research field known as *game studies*, revealing a fundamental connection between humans and games throughout history. Scholars such as *Johan Huizinga* and *Eugen Fink* have emphasized the innate human tendency to play, which coexists with our rational and creative

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faculties [6] [7]. This innate aspect of human nature underscores the effectiveness of games as educational tools that through their ability to incorporate competition, engagement and immediate feedback, motivate participants and facilitate learning and development.

As technology has advanced, traditional games have evolved into educational digital games, often referred to as *serious games* or applied games. Unlike pure videogames, serious games are designed with primary purposes such as education, training, and information dissemination [8]. They cover a wide range of fields, including defense, education, scientific exploration, healthcare, emergency management, city planning, engineering, and politics [9][10][11][12].

In the context of Cybersecurity, Serious games are pivotal for educating individuals on best practices, recognizing threats, and handling cyber incidents. By allowing learners to explore diverse scenarios beforehand, they can make informed decisions when using the Internet or computers in their daily activities. For example, the *The Weakest Link*<sup>1</sup> [13] is a game where players take on the role of a security expert within a company. Its primary objective is to maintain high levels of security within the organization by addressing the various security challenges that arise every day, in the form of multiple variable questions and answers. The uniqueness of the game consists in the fact that the challenges are generated by the choices of the company's employees, where the player cannot choose the difficulty level. Also, the decisions made by the player (the security expert) during the game can change the company's destiny very quickly, which is why the game is very dynamic, making the employee "the weak link in the company". The key components of the game include:

- *Security Score*: this metric quantifies the player's effectiveness in safeguarding the company against potential threats.
- *Daily Challenges*: each day presents new security scenarios, accompanied by questions and multiple solutions for the player to consider.
- *Workdays*: these represent the progression through different levels of the game, with each workday indicating the challenges faced and those remaining to be addressed.

In the game *Keep Tradition Secure*<sup>2</sup> [14] players are immersed in a college campus. His main goal is to defend the students and catch the hacker called "Bad Bull" who threatens the campus through a series of questions with three multiple answers. The peculiarity of the game is that it has a large game space (the entire campus map), but remains static in story and challenges. The main parts of the game include:

- *Map*: used to navigate the campus in search of the hacker.
- *Challenge*: once you reach the point indicated on the map, a question appears with related answer options.

In the [15] *Riskio* is presented, a classic serious board game designed to increase awareness and knowledge about cyber attacks. *Riskio* addresses the limitations of existing cybersecurity awareness games by offering an active learning environment where players can learn about different attacks and countermeasures while playing the role of both the attacker and defender of critical assets in a fictional organization. The main components of the *Riskio* game are: *Card Decks* and the *Game Board*. The *Card Decks* are:

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<sup>1</sup><https://www.isdecisions.com/user-security-awareness-game/>

<sup>2</sup><https://keeptraditionsecure.tamu.edu/>

- *Attack deck*: contains the most common threats and attack vectors identified in cybersecurity reports;
- *Defense deck*: presents possible countermeasures and defenses against attacks;
- *Information deck*: provides additional details and useful information for the game.

The *Game Boards* represents a fictional organization and provides context for the game, allowing players to view and interact with attacks and defenses. The paper identifies three main limitations of existing games:

- *Lack of exposure* to a wide range of cyber attacks and possible countermeasures;
- *Lack of opportunity* for players to practice both offensive and defensive skills;
- *Difficulty* easily adapting or modifying the game for different training needs and contexts.

This research is motivated by the fact that there are no serious games on cybersecurity in the Italian language intended for a teen audience, with the possibility of choosing the level of difficulty based on their knowledge and skills and the possibility of adding new topics easily.

The rest of this paper is organized as follows. Section 2 begins with an overview of the game, followed by a discussion of its conception, unique features, and design methodology. In Section 3, we delve into the analysis of a user study conducted to evaluate the game's effectiveness. Finally, Section 4 concludes by presenting potential avenues for future research.

## 2. The serious game CyberDuel

*CyberDuel* combines a card game with a quiz game to introduce young students to the topic of computer security in an interactive way. The approach used is the one commonly used in cybersecurity contexts, a competition between the red and blue team. Users are actively involved in the process of defending themselves against threats posed in the form of hackers. Users assume the role of the "blue team" and must defend themselves against cyber threats represented by the "red team" (hackers). The game is a card battle where players must select cards in response to the hacker's moves, make strategic decisions based on the analysis of card attributes, and predict their opponent's actions to maximize their chances of success based on card scores. The player who loses all his life points loses the game.

In the preliminary stages of game conceptualization, we set ourselves the goal of creating an engaging and innovative experience. We found inspiration from the basic idea of the game *Hacket*, which under GPL-3.0 license control, provided us with an exciting starting point.

One of the main focuses was to understand how to transform the basic idea of the game *Hacket* into something new and distinctive. *Hacket* is a static game with a single level and with few and very generic questions about cybersecurity, but with a very clear and explicit aesthetic, regarding the player's roles and the purpose of the game. *CyberDuel* is based on *Hacket*'s aesthetic, using their patterns, colors, incorporating dynamics such as multiple difficulty levels and more diverse content. Specifically, the game's content has been expanded to cover important topics such as cyberbullying, password security, data privacy, phishing attacks, social engineering tactics, and GDPR regulations. A key aspect highlighted in *CyberDuel* is its accessibility to a broader audience, in particular that of being able to change the language of the game and propose the

game to an audience of Italian teenagers. Finally, to facilitate understanding of these concepts, the game offers feedback after each round to help players better understand the material.

In the development of *CyberDuel*, we followed an *iterative design process* [16] to refine and improve the game mechanics and user experience iteratively based on testing and feedback. In the following sections, we delineate certain facets of the planning and design phases.

## 2.1. Planning

During the planning phase, we outlined a number of specific objectives that we wanted to achieve in our project, integrating and expanding on the basic idea to fit our original concept, respecting the guidelines for creating a serious game, described later in the design section.

An in-depth analysis of the game planning was conducted, carefully considering:

- **Primary goal:** educate players about cybersecurity in an interactive way, addressing the critical need for awareness and knowledge in digital security.
- **Secondary goals:**
  1. *Enhance understanding* of cybersecurity principles through practical application: reinforce cybersecurity concepts through practical application within the game environment.
  2. *Improve decision-making skills* in a simulated environment to be ready for a possible real case of hacking: the game aims to sharpen their ability to assess risks, devise effective countermeasures, and respond swiftly to cyber threats.
- **Target Audience:** individuals who are interested in learning about cybersecurity, with the properties describe in table 1.
- **Game Genre(s):**
  1. *card game:* choose cards that represent different countermeasures to attacks;
  2. *quiz game:* make informed decisions in response to evolving scenarios.

**Table 1**  
Target audience

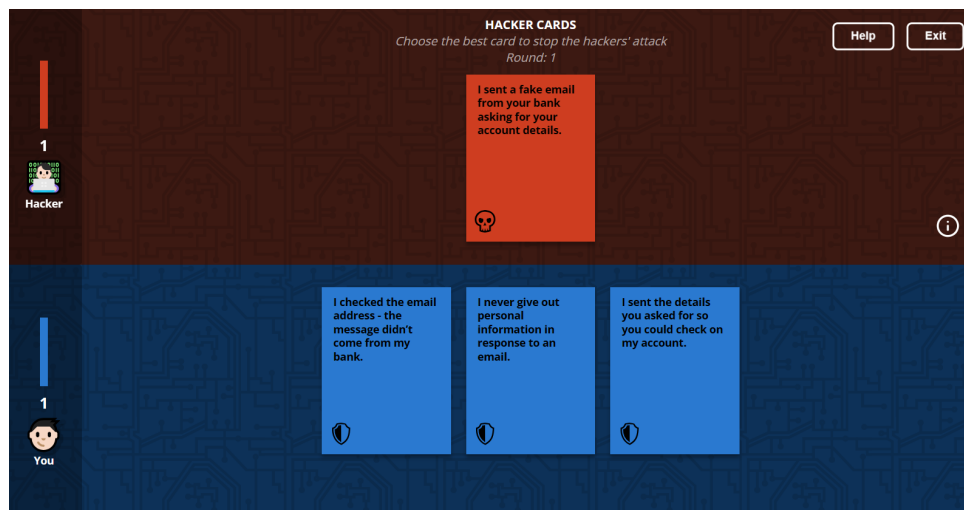
| Item                            | Learner  |
|---------------------------------|--|
| <i>Age</i>                      | 14 years and older   |
| <i>Educational level</i>        | High school and above  |
| <i>Motivation</i>               | Individuals interested in cybersecurity and online safety      |
| <i>Prerequisite knowledge</i>   | Basic understanding of computer systems and the internet       |
| <i>Prerequisite skills</i>      | Fundamental problem-solving skills                             |
| <i>Facility with a computer</i> | Basic computer literacy  |
| <i>Familiarity with web</i>     | Moderate familiarity with web browsers and online interactions |
| <i>Typing ability</i>           | Basic typing skills  |
| <i>Access to computers</i>      | Required   |
| <i>Access to web</i>            | Required   |
| <i>Time availability</i>        | 5/30 minutes   |

- **Platform:** the game is developed as a browser-based application using HTML, CSS and TypeScript, ensuring accessibility on a wide range of devices and exploiting the Angular framework to simplify development and improve code organisation.
- **Look and Feel:** the main colours of the game are blue and red, in different shades, mixing cold and warm tones, symbolising the ongoing battle between the blue team (i.e. the player) and the red team (i.e. the hacker).

## 2.2. Design

The design of a game includes the delineation of various elements according to the requirements and resources specified during the planning phase. To enhance the design process, we have adopted the *Elemental Tetrad framework* [17]. This framework was chosen for its comprehensive coverage and proven effectiveness in guiding game design, ensuring thorough consideration of essential game elements delineated into four distinct categories:

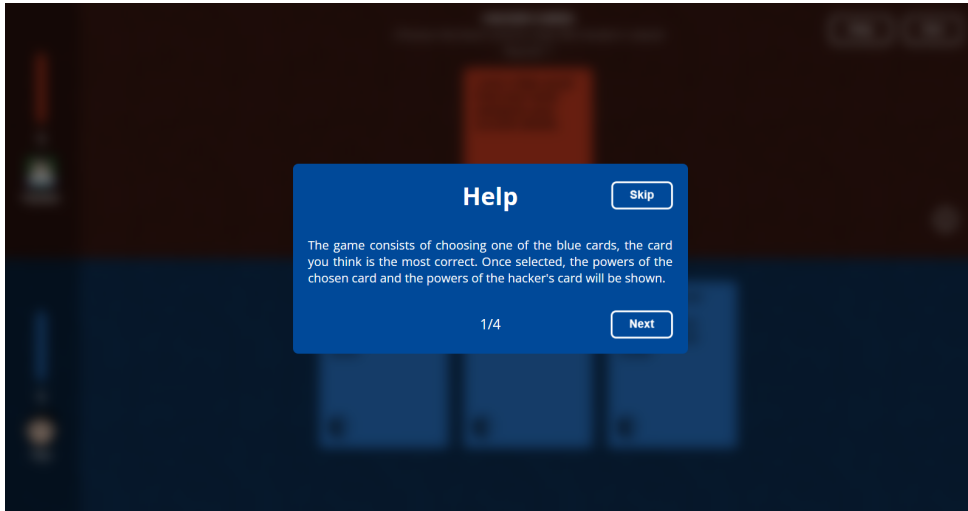
- **Mechanics:**
  1. *Space:* the game is confined to digital space, divided horizontally into two conceptual areas: one belongs to the player and the other to the hacker, following the typical standard of digital card games (Figure 1) . In this representation, the duelists are arranged facing each other in a top-down perspective, similar to the layout on a real card table.
  2. *Objects:* cards serve as interactive objects characterized by two static attributes: a description detailing the available counter moves for the player in response to the opponent's actions, and power, which indicates the effectiveness of the action represented by the card. Additionally, life points serve as dynamic attributes in the game, representing the quantitative measure of health of the duelists. These life points decrease over the course of the game according to the results of each turn.



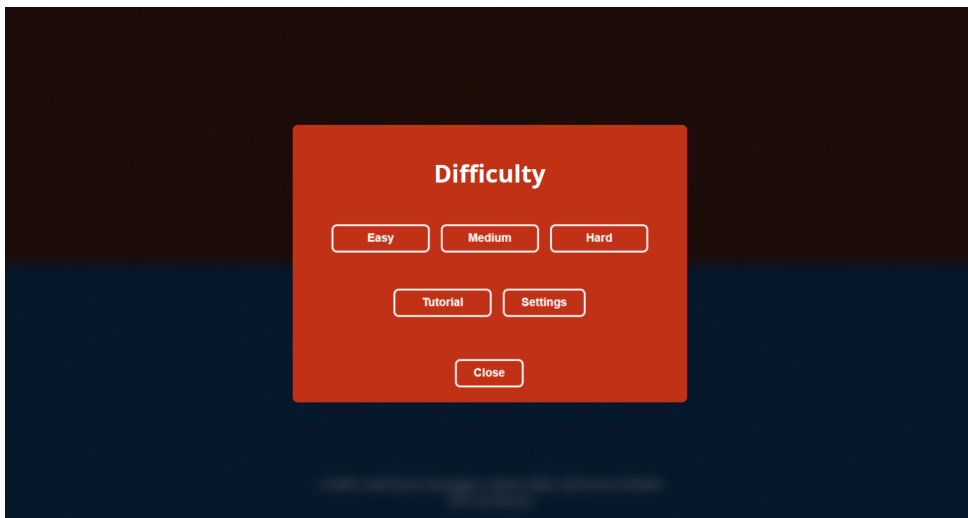
**Figure 1:** Space of the game divided in two area

3. *Actions*: throughout gameplay, the player is involved in each round in the strategic action of deciding which card maximizes their chances of success by analyzing and comparing card descriptions. The player then performs the basic action of selecting the card that will face the opponent's card, initiating the clash.
  4. *Rules*: the outcome of clashes between the player's chosen card and the opposing card is determined by their respective powers. If one card has greater power than the other, it inflicts damage equal to the difference in points to the duelist who chose the less powerful card. However, if the powers are equal, no damage is dealt. The duel concludes in one of two ways: either when one side loses all its life points, resulting in defeat, or when the predetermined number of rounds for the level has ended, leading to a draw.
  5. *Skills*: a crucial skill we expect players to possess is the mental aptitude for decision-making, as the game requires a thorough understanding of card details.
  6. *Chance*: *Hacket* is a very static game lacking of chance elements, consequently to create an experience that is always full of challenging decisions and that prioritizes player engagement in scenarios rather than rote memorization of moves, we introduce two unpredictable elements. The first element is that the scenarios encountered during the levels may change each time, the second element the cards presented to the player for each scenario are randomly ordered, intensifying the demand on players to remain attentive and responsive during the duel.
- **Story**: the narrative is *implicit*, revolving around a virtual battlefield where *two characters*, the blue team member (i.e. the player) and the red team member (i.e. the hacker), engage in an ongoing conflict. Each round represents a distinct scenario or event that the player must navigate, contributing to an *embedded narrative* that evolves as players progress through the game.
  - **Aesthetics**: based on the *Hacket* game, some patterns were reused regarding the aesthetics, but new *prototypes* and *storyboards* of the game were also defined and generated. The *mission* and the *challenges structure* are defined in terms of:
    1. *mission design*: the game has different levels and for each level is structured around a series of cybersecurity rounds;
    2. *progressive complexity*: the levels gradually increase in complexity, introducing new cybersecurity threats and tactics as players advance. This structure ensures a steady learning curve, allowing players to build upon their knowledge and skills;

A crucial point of this game, that differs from the *Hacket* game, is the concept of levels. The game consists of a *training level*. Within this stage, the game unfolds the goal and all its mechanisms (Figure 2), providing detailed insights and invites the player to select a card from the hand. The instruction section can be called up from any level. Afterwards, the player receives constructive feedback on the chosen card. Once the tutorial level is successfully completed, an ending screen of the game is presented, taking the player back to the home page for further exploration. The player, from the main menu, can choose a new game with different difficulty levels (Figure 3). The challenges escalate progressively, the player's life points decrease, shifting the balance in favor of the hacker's life, transitioning from easy to medium to difficult level.



**Figure 2:** Game instructions explaining the purpose and mechanics



**Figure 3:** Menu of difficulties and the settings section to change the language

- **Technology:** *CyberDuel* it was completely rewritten from scratch using Angular (v17), a TypeScript-based framework, along with HTML and CSS. In the development process, we were inspired by the aesthetics and movements of the *Hacket* game. The difficulties encountered in the porting were recreating the animations of card selection and the different dynamics on the players' scores.

### 3. User Study

In this section, we present the methodology and results of our user study, which was designed to test the effectiveness of 'CyberDuel' game. We conducted a beta test involving a diverse group of participants, assessing their cognitive skills and learning outcomes using the *Gameful Experience Scale (GAMEX)* [18]. The *GAMEX* serves as a tool to measure users' gameful experiences in gamified contexts. The decision to employ the *GAMEX* stems from its adaptability across various contexts and its simplicity in pinpointing specific experiential qualities that must be refined to improve the gamified application, by-passing risky trial-and-error adjustments [18].

#### 3.1. Questionnaires

After the beta test session, participants were given a questionnaire. The first part was made up of socio-demographic data. This included age, gender, and their experience in the field of cybersecurity (i.e. "weak", "average" and "high"). The second part was based on the *GAMEX* test, comprising 27 items across six dimensions: *Entertainment (Enj 1-6)*, *Absorption (Ab 1-6)*, *Creative thinking (CT 1-4)*, *Activation (Act 1-4)*, *Absence of negative affects (ANA 1-3)* and *Dominance (Dom 1-4)*. Participants rated their level of agreement on a 7-point Likert scale (1 = "strongly disagree", 7 = "strongly agree", except for the question "Absence of negative affects" where the values were reversed) for each question of each dimension.

#### 3.2. Sample and Procedure

The beta testing phase of our study was designed to simulate real-world usage scenarios, providing participants with an authentic experience of the system's capabilities. The test involved a carefully selected group of 12 participants, including 6 males and 6 females, aged between 15 and 25 (average 21 years old) and with different experiences in the cybersecurity field (4 people for each type of experience). Participant recruitment used convenience sampling, prioritizing availability and proximity to the authors for selection.

#### 3.3. Results and Discussion

After obtaining the results of the questionnaire, the mathematical average of the scores for each question of each dimension was calculated. Subsequently, to report them on a centesimal scale in order to define a graph, the average score of each dimension was calculated, then divided by the total number of responses and multiplied by 100. The results of the user test are shown in the table 2 where zero is the lowest value and 100 is the highest value.

As visible from the Figure 4,

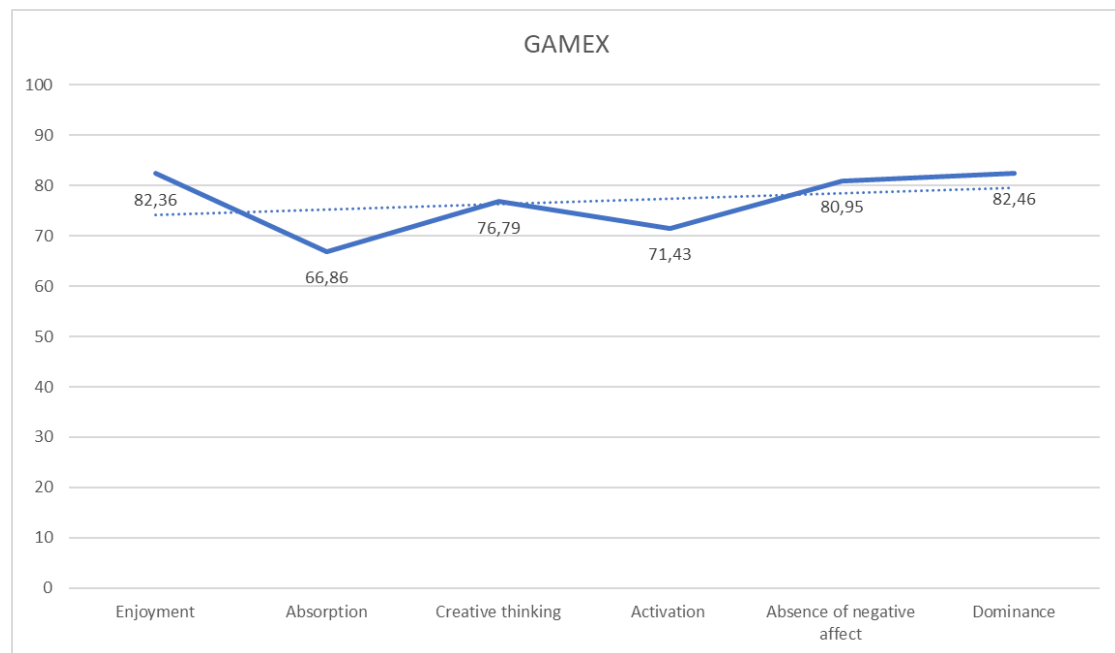
some interesting and encouraging results were obtained:

- **Enjoyment:** the participants demonstrated a high level of enjoyment while engaging with the serious game, scoring an impressive 82,36. This suggests that the game successfully captivated their interest and provided an enjoyable experience.
- **Absorption:** the level of absorption among the participants was notable, with a score of 66,86. This indicates that the game was effective in immersing the players in its content, fostering deep engagement and concentration.



**Table 2**  
Questionnaire Result

|              |       |             |       |             |       |              |       |              |       |              |       |
|--------------|-------|-------------|-------|-------------|-------|--------------|-------|--------------|-------|--------------|-------|
| <b>Enj 1</b> | 5,67  | <b>Ab 1</b> | 5,17  | <b>CT 1</b> | 5,08  | <b>Act 1</b> | 6,08  | <b>ANA 1</b> | 5,33  | <b>Dom 1</b> | 5,42  |
| <b>Enj 2</b> | 6,17  | <b>Ab 2</b> | 4,33  | <b>CT 2</b> | 5,42  | <b>Act 2</b> | 4,42  | <b>ANA 2</b> | 6     | <b>Dom 2</b> | 5,25  |
| <b>Enj 3</b> | 5,92  | <b>Ab 3</b> | 4,83  | <b>CT 3</b> | 5,58  | <b>Act 3</b> | 4,42  | <b>ANA 3</b> | 5,67  | <b>Dom 3</b> | 6,42  |
| <b>Enj 4</b> | 5,75  | <b>Ab 4</b> | 4,83  | <b>CT 4</b> | 5,42  | <b>Act 4</b> | 5,08  |              |       | <b>Dom 4</b> | 6     |
| <b>Enj 5</b> | 5,5   | <b>Ab 5</b> | 4,17  |             |       |              |       |              |       |              |       |
| <b>Enj 6</b> | 5,58  | <b>Ab 6</b> | 4,75  |             |       |              |       |              |       |              |       |
| <b>Avg</b>   | 5,77  |             | 4,68  |             | 5,38  |              | 5     |              | 5,67  |              | 5,77  |
| <b>Perc.</b> | 82,36 |             | 66,86 |             | 76,79 |              | 71,43 |              | 80,95 |              | 82,46 |



**Figure 4:** Chart of questionnaire results

- **Creative Thinking:** The serious game elicited a strong response in terms of creative thinking, scoring 76,79. This suggests that it stimulated participants' imagination and encouraged them to explore innovative solutions within the game's context.
- **Activation:** the score of 71,43 for activation indicates that the game effectively prompted participants to become actively involved in its challenges and tasks. This suggests that it succeeded in motivating them to participate and interact with its content.
- **Absence of Negative Affect:** with a score of 80,95, the game demonstrated a notable absence of negative affect among the participants. These findings align with those of the original researchers, suggesting that the absence of negative emotions is crucial for the genuine emergence of the gaming experience [18].
- **Dominance:** the high score of 82.46 for dominance suggests that the game effectively

empowered participants and allowed them to feel in control of their actions within the game environment. This indicates a positive user experience, where players felt confident and competent in navigating the challenges presented.

## 4. Conclusion and Future works

*CyberDuel* educates players on cybersecurity, leveraging game-based learning to enhance awareness and decision-making skills. The innovative design, incorporating elements like card strategies and dynamic scenarios, engages players in a non-threatening environment.

Some possible future works could include:

- **Enhancing User Engagement:** further research could focus on increasing user engagement by incorporating more interactive elements, personalized feedback, or gamification techniques to make the learning experience more immersive and enjoyable and to be able to have greater user absorption while playing the game.
- **Expanding Content and Scenarios:** to develop additional levels, challenges, and scenarios within the game to cover a broader range of cybersecurity topics and real-world situations, catering to different skill levels and learning preferences of users.
- **Integration of Advanced Technologies:** to explore integrating emerging technologies like virtual reality (VR) or augmented reality (AR) to enhance the gaming experience and provide a more realistic and interactive learning environment.
- **Long-term Impact Assessment:** to conduct longitudinal studies to evaluate the game's long-term impact on users' cybersecurity knowledge, skills, and behaviors, tracking progress and retention of information over time.
- **Collaboration and Partnerships:** to collaborate with cybersecurity experts, educational institutions, and industry partners to gather feedback, validate effectiveness, and ensure alignment with current cybersecurity practices and trends.
- **Accessibility and Localization:** to adapt the game to be accessible to a wider audience by translating it into multiple languages, optimizing for different devices, and ensuring inclusivity for users with diverse learning needs.
- **Larger Participant Pool:** to obtain a larger range of feedback and different perspectives for a more comprehensive understanding of the game's impact.

By exploring these avenues for future research and development, the *CyberDuel* project can continue to evolve and make a significant impact in educating individuals about cybersecurity through innovative and engaging game-based learning experiences.

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## References

- [1] A. Chrysanthou, Y. Pantis, C. Patsakis, The anatomy of deception: Measuring technical and human factors of a large-scale phishing campaign, *Computers & Security* (2024) 103780.
- [2] A. Pollini, T. C. Callari, A. Tedeschi, D. Ruscio, L. Save, F. Chiarugi, D. Guerri, Leveraging human factors in cybersecurity: an integrated methodological approach, *Cognition, Technology & Work* 24 (2022) 371–390.
- [3] A. Joinson, T. van Steen, Human aspects of cyber security: Behaviour or culture change?, *Cyber Security: A Peer-Reviewed Journal* 1 (2018) 351–360.
- [4] V. Zimmermann, K. Renaud, Moving from a ‘human-as-problem’ to a ‘human-as-solution’ cybersecurity mindset, *International Journal of Human-Computer Studies* 131 (2019) 169–187.
- [5] M. Prensky, Digital game-based learning, *Comput. Entertain.* 1 (2000) 21. URL: <https://api.semanticscholar.org/CorpusID:207742354>.
- [6] K. Salen, E. Zimmerman, *The Game Design Reader: A Rules of Play Anthology*, Chapter 3: Interstitial: Urban Invasion : Nature and Significance of Play as a Cultural Phenomenon, *The Definition of Play and The Classification of Games*, The MIT Press, 2006.
- [7] I. Schousboe, D. Winther-Lindqvist, *Children’s Play and Development: Cultural-Historical Perspectives*, Chapter 15: Play, But Not Simply Play: The Anthropology of Play, 2013. doi:10.1007/978-94-007-6579-5.
- [8] D. Michael, S. Chen, *Serious games: Games that educate, train, and inform* (2006).
- [9] Y. M. Arif, N. Ayunda, N. M. Diah, M. B. Garcia, A systematic review of serious games for health education: Technology, challenges, and future directions, *Transformative Approaches to Patient Literacy and Healthcare Innovation* (2024) 20–45.
- [10] Z. Feng, V. A. González, C. Mutch, R. Amor, G. Cabrera-Guerrero, Exploring spiral narratives with immediate feedback in immersive virtual reality serious games for earthquake emergency training, *Multimedia Tools and Applications* 82 (2023) 125–147.
- [11] N. Stathakarou, A. A. Kononowicz, C. Swain, K. Karlgren, et al., Game elements in the design of simulations in military trauma management training: Protocol for a systematic review, *JMIR Research Protocols* 12 (2023) e45969.
- [12] V. Rossano, G. Calvano, Promoting sustainable behavior using serious games: Seadventure for ocean literacy, *IEEE Access* 8 (2020) 196931–196939.
- [13] W. Hill, M. Fanuel, X. Yuan, Comparing serious games for cyber security education, in: *Proceedings of the 2020 ASEE Southeastern Section Conference*, Auburn, AL, USA, 2020, pp. 8–9.
- [14] M. Calvano, F. Caruso, A. Curci, A. Piccinno, V. Rossano, et al., A rapid review on serious games for cybersecurity education: Are “serious” and gaming aspects well balanced?, in: *IS-EUD Workshops*, 2023.

- [15] S. Hart, A. Margheri, F. Paci, V. Sassone, Riskio: A serious game for cyber security awareness and education, *Computers & Security* 95 (2020) 101827.
- [16] C. Larman, V. R. Basili, Iterative and incremental developments. a brief history, *Computer* 36 (2003) 47–56.
- [17] J. Schell, *The Art of Game Design: A Book of Lenses*, Chapter 5: The Game Consists of Elements, 3rd ed., A K Peters/CRC Press, 2019.
- [18] R. Eppmann, M. Bekk, K. Klein, Gameful experience in gamification: Construction and validation of a gameful experience scale [gamex], *Journal of interactive marketing* 43 (2018) 98–115.

## **6. Online Resources**

- The sources for the original idea of the games is available on this [GitHub \(Hacket\)](#), under GPL-3.0 license control.
- The sources for CyberDuel game is is available on this [GitHub \(CyberDuel\)](#), under GPL-3.0 license control.