Healthcare gamification
Serious game about COVID-19;
Stay at home.

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ABSTRACT
Serious games are games whose primary aspirations go beyond pure entertainment. With a distinct learning agenda, they encourage learning through interaction with real-world issues. This research of this thesis was aimed at evaluating serious games as an effective educational tool to teach young adults about prevention measures that could mitigate the spread of COVID-19.

The design process combines game research methods with qualitative and quantitative means to evaluate people's attitudes and knowledge gain towards the problem domain. The result of this design process, is Stay at Home, a serious game containing different microgames that teach the target group about guidelines and recommended prevention and hygiene measures against the virus. Playtesting the game revealed a small gain and slight change in player's attitudes. The game requires further adjustments to enhance playability and player engagement, but offers a promising approach to educate an age-group through a highly interactive medium.
INDEX

1. OUTLINE  
  1.1 Introduction  
  1.2 Research Question  
  1.3 Ethical considerations  

2. BACKGROUND AND THEORY  
  2.1 Symptoms  
    2.1.1 Guidelines and recommendations  
    2.1.2 The Impact of Online Information during COVID-19  
    2.1.3 Human Behavior During Pandemics  
    2.1.4 Target audience  
  2.2. Gamification  
    2.2.1 Gamification and Games  
    2.2.3 Serious Games for Health  
    2.2.4 Learning benefits expected from Serious Games  
    2.2.5 Evaluating serious games in education  
  2.3. Canonical Examples  
    2.3.1 Plague Inc.  
    2.8.2 The great flu  
    2.8.3 Stop the Spread! e-Bug Junior  
    2.8.4 Pandemic  
    2.8.5 Canonical examples conclusion  

3. METHODS  
  3.1 Project plan  
  3.2 Double Diamond  
    3.1.1 Discover  
    3.1.2 Define  
    3.1.3 Develop  
    3.1.4 Deliver  
  3.3 Human-centered design research  
  3.4 Unstructerced interviews  
  3.5 Secondary Research & Survey  
  3.6 Cultural Probes & Gamestorming  
  3.7 Playtesting Methods  

4. DESIGN PROCESS  
  4.1 Discover  
    4.1.1 Preliminary overview  
    4.1.2 Unstructured Interviews  
    4.1.3 Secondary Research & Netnography  
    4.1.4 Survey  
    4.1.5 Insights survey  
    4.1.6 Conclusion  

5
1. OUTLINE

1.1 Introduction

In December 2019, a pneumonia outbreak of unknown etiology in Wuhan, China, quickly spread worldwide. The Chinese Center for Disease Control and Prevention (CCDC) identified a novel beta-coronavirus called 2019-nCoV, now officially known as Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) (Gorbalenya et al., 2020). The rapid spread of this virus has become a global threat to our society and our lives. Since the World Health Organization (WHO) declared SARS-CoV-2, also known as COVID-19, a pandemic on March 11, 2020, COVID-19 has led to the implementation of extraordinary public health measures to reduce further spread within China and elsewhere. In the middle of a health crisis, everything normal about our daily lives is being put on hold, jeopardizing our personal and professional lives and our physical and mental well-being. However, despite the restrictions and the terms that the virus is dictating in our lives, comparatively young and healthy individuals may think they are unlikely to get sick, let alone die. Recent events, testimonies, and reports relating to this group suggest that the message has not been getting through to everyone.

This leads us to assume that existing mediums of information either lack efficiency or have been unable to engage specific audience demographics sufficiently as a resource on pandemic-related knowledge. The goal of this thesis is to create a channel of information, a serious game, which refines and repackages crucial knowledge on pandemics through gamification, to engage and educate demographics that haven’t been influenced sufficiently by existing channels. According to Corti, (2006), game-based learning or serious games are “all about leveraging the power of computer games to captivate and engage end-users for a specific purpose, such as to develop new knowledge and skills.” (Corti, 2006). It has been used successfully in further educational contexts, even healthcare. According to Roubidoux et al. (2009), many serious games in the area of e-health have been developed, which deal with a wide variety of features for patient care.

This thesis is divided into six chapters. The first chapter consists of the theoretical grounding and research used to frame the game design - context of COVID-19, measures to contain the contagion, serious games for healthcare to create awareness and educational games, and designing. The second chapter introduces four types of serious games that served as inspirations and references for the game’s design. The third chapter elucidates on the double diamond model used to design the game to understand how the design process was chosen and why. The fourth chapter, the core of the thesis, goes through each method and process, elaborates on design decisions, and how it was relevant to the final prototype and evaluation. The fifth chapter shows results from the game evaluation and assesses whether the design process was fruitful concerning the game. In the last chapters, future work and design openings are explored.
1.2 Research Question
How can serious games be used as an educational tool to raise awareness about the risks of pandemics to contain the expansion of COVID-19?

1.3 Ethical considerations
Names and information of users who participated in interviews, play-testing, and cultural probes will be protected and not shared in this report, as stated in the participation agreement in Appendix 1. Future photographs that appear in the project have been reviewed and accepted by the subjects that appear on them.
2. BACKGROUND & THEORY

2.1. COVID-19: Context, Symptoms and Modes of Transmission

Preceding outbreaks of coronaviruses (CoVs) cover the Severe Acute Respiratory Syndrome (SARS)-CoV and (MERS)-CoV, Middle East Respiratory Syndrome, which has been previously characterized as agents of an enormous public health threat (Shereen, Khan, Kazmi, Bashir & Siddique, 2020).

SARS-CoV-2 is a distinct strain of coronavirus that has not been previously identified in humans. The incubation period of this strain is unknown. Still, the United States Center for Disease Control and Prevention and World Health Organization (WHO, 2020) indicate that symptoms may arise in as few as two days or as long as 14 days after exposure. However, some literature suggests that the incubation period can persist longer than two weeks, and it is feasible that a longer incubation period could reflect double exposure (Han et al. 2020). What makes this pandemic dangerous is that analysis suggests that half of all transmissions occur in the early stages of the infection, before it even reveals any symptoms of the disease, i.e., when patients are asymptomatic (Gorbalenya et al., 2020).

According to the WHO (2020), the most common symptoms of COVID-19 illness are fever, and fatigue and cough, while other symptoms include sputum production, headache, haemoptysis, diarrhoea, dyspnoea, and lymphopenia. Since there is no current vaccine or antivirals available for treatment, according to WHO (2020), the application of preventive measures is essential for mitigating the spread of the virus worldwide. As stated by WHO (2020), persons over 65 years of age are more susceptible to severe coronavirus infections. Other high-risk demographics are individuals with pre-existing conditions that significantly impair the functioning of the lungs, heart or immune system, severe heart disease, lung disease that is not clinically stabilized, chronic liver or kidney failure, diabetes that involves organ damage, diseases that weaken the immune system such as leukemia or lymphoma, and even medication which significantly weakens the immune system as a side-effect.

Transmission of the COVID-19 virus can arise by staying in direct contact (within 1 m) of infected people and indirect contact with surfaces in the immediate environment or with objects used on the infected person. According to WHO (2020), airborne transmission is also highly plausible. It may also be possible in specific circumstances and settings where procedures or support treatments that generate aerosols are performed - bronchoscopy, open suctioning, the patient to the prone position, disconnecting the patient from the ventilator, cardiopulmonary resuscitation.

2.1.1 Guidelines and recommendations

According to the WHO (2020), some of the guidelines and measures to contain the contagion of the virus may include:
1) Avoiding physical contact while greeting; safe greetings include a wave, a nod or a bow.
2) Cover the nose and mouth with tissue or a bent elbow when sneezing or coughing, and immediately disposing of the used tissue.
3) Washing one’s hands regularly with soap and water or using alcohol-based rub for at least twenty seconds.
4) Keeping distance of at least 1 metre from someone who is coughing or sneezing, as well as keeping enough distance in public places. The minimal distance recommended is 1.5 metres.
5) In presence of cough, fever, and difficulty in breathing, one must wear a mask correctly and seek medical advice. Many countries have prohibitions of public gatherings of more than 50
people. It is important that in case of self-isolation, to not visit other people's homes or socialize outside one's home. If unwell, one must isolate themselves and their family. Citizens belonging to countries with no restrictions on outdoor movement are recommended to only leave home for essentials, shopping, medical needs and exercise once a day.

2.1.2 The Impact of Online Information during COVID-19
On the internet, people have access to an endless stream of information regarding the COVID-19 pandemic outbreak. Not only that, but through social media, people have also spread and shared news and articles as well as their own experiences about the pandemic, allowing immediate access to global development (Farooq, Laato & Islam, 2020). Although the vast amount of online data can be useful for artificial intelligence and machine learning algorithms, it can pose a large number of difficulties for individuals to grasp. As stated by the same authors, two main problems can appear from excessive internet use during a worldwide pandemic. The first is cyberchondria, defined as an obsessive online searching behaviour for online health-related information. The second is an information overload, which is when a person cannot process all the communication and informational inputs. As a result, the information gathering process remains ineffective. Both problems, cyberchondria, and information overload have been proven to weaken human cognitive reasoning, according to Starcevic and Berle, (2013).

2.1.3 Human Behaviour During Pandemics
When the amount of knowledge crosses one's processing capacities, the cognitive load theory postulates that the natural human reaction in such situations is to take a step away from the source of the information overload. Information overload distorts people’s belief systems, particularly coping appraisal during a pandemic. In particular, information overload negatively affects self-efficacy and positively influences response costs. Moreover, cyberchondria changed the perceptions of perceived difficulty and perceived vulnerability, affecting people's threat assessment during pandemics, such as COVID-19. Although cyberchondria is generally regarded to be negative, in the case of COVID-19, it might help individuals to grasp the actual gravity of the situation. It is important to note that although people with cyberchondria may be first adopters of self-isolation behaviour, they can, in the long run, suffer from stress and anxiety due to regularly seeing news highlighting the severity of the situation, (Farooq, Laato & Islam, 2020).

2.1.4 Target audience
Sarah T. Stahl (2013) states that there is an association between perceived vulnerability to disease, aging knowledge, and ageism. Due to continuous reporting, older adults are likely to be at higher risk. Information bias occurs, causing many young adults to consider not taking the threat of the virus seriously. This bias is compounded by the observation that young adults have significantly lower mortality rates and are more likely to contract a moderate case of the virus than older adults. This information bias makes young adults more likely to ignore or flout crucial regulations against the pandemic. When coupled with the long incubation period of the virus, it makes young adults ideal conduits for spreading viruses to high-risk groups in their vicinity, or worse, makes them more likely to be super-spreaders. Thus, in this thesis, young adults are the target audience.
2.2 Gamification

2.2.1 Gamification and Games

The term ‘gamification’ is utilized to describe the application of game mechanics or motivational techniques in a non-game environment (Lee and Hammer, 2011) or as (Deterding et al., 2011, p.9) suggest “the use of game design elements in non-game contexts.” By this definition, game is a structured, goal-oriented effort, in contrast, to play, which may lack clear boundaries and goals. Or, as (Deterding, 2011; Zhang, 2008) have suggested, the underlying idea of gamification is to use the specific design features or “motivational affordances of entertainment games in other systems to increase engagement.” (Zichermann and Cunningham, 2011) define gamification as the process of using game mechanics and game thinking to engage audiences and solve problems. The main elements of gamification are as follows: (a) Game elements: points, badges, leader boards, (b) Game methods: thinking as a computer game designer and (c) Non-game settings in other business domains such as education, entertainment, health, business, and marketing. There is a vast level of discussion on which extent gamification would lead to a revolution, according to (Zimmerman, 2013), or how it affects our lives (Fuchs, 2014). As some authors like (Raessens, 2006) have pointed out, game elements are increasingly introduced in our lives and have allowed us to create new opportunities to influence people’s behaviour for a better world; a phenomenon labelled “ludification of culture”. In “The Gameful World,” (Deterding and Walz, 2014) explain that game design is the practice of creating enjoyable and playful interactions, allowing people to become more engaged in complex and mundane activities. It is the extension of the magic of a circle of play that has motivated players to accomplish activities like foursquare check ins, quantified self-movement and even change behavior patterns to be more sustainable or do more social good. Deterding mapped the current use of games and play by dividing them into two dimensions: whole systems versus qualities/elements, and “paida” versus “ludus.” Deterding defines paida as open and pretend play, and ludus as being a more goal-oriented and rule-based game. (Figure1. – shows the diagram mapping the current use of game and play, dividing them into two different dimensions: paida versus ludus, and whole versus elements.).

Figure 1. Gameful world (From “The gameful world” 2014).

To develop on the paired idea of having a serious game, Deterding proposes a different dimension to distinguish between the full and partial application of the modes of play into a given experience. There are circumstances in which an experience needs to include qualities or elements of either paidic or ludic play, and by doing this, the experience can be fitted as a
playful or gameful design. This theory will not only help ideation and prototyping but will also keep the character of the project oriented towards the modes of playing, and to mapping every design proposed inside the game design spectrum.

2.2.2 Serious games for health-care

Serious games can utilize inexpensive technology as well as expensive simulators and are scientifically validated since the development phase includes researchers and experts involved in testing the game, according to Remi van Loenen, (2019). In the last decade, many serious games in the field of e-health have been produced (Roubidoux, Chapman, & Piontek, 2009). These games deal with a wide variety of aspects, such as surgeon training, radiology operation, cardiopulmonary resuscitation (CPR), and patient care. Many researchers, such as Gos-tin, (2000) have pointed out the necessity of highly trained and educated health care experts to avoid medical errors. The application of serious games in health can contribute an additional means to develop an interest in education, training, and evaluation of the performance of patients and health professionals. From the patient’s perspective, games can have direct or indirect positive physiological and psychological effects on individuals (Watters et al., 2006), precisely the aim of serious games in healthcare. Watters et al. (2006) investigated the use of games for children with long term treatment regimes, where the motivation for compliance is a critical factor in the termination of the treatment.

Serious games offer immediate feedback and adaptability. As games have a quantifiable result, players are immediately able to assess their progress. Since evaluation is achieved by an automatic system, players might recognize the assessment to be less stressful or uncomfortable. Based on the assessment, the game can adjust parameters—for example, the complexity level—to the individual player. As a result, serious games are capable of giving users emotional, cognitive, or physical challenges that are neither too easy nor too difficult. Moreover, serious games can engage a user in a simulated world, where anomalies are integrated to influence problem-solving strategies and improve their self-efficacy.

Furthermore, studies have demonstrated that players and users who participate in serious game training have better results than other patients that experience traditional processes of learning. In studies such as Buttussi and Pellis,(2013), authors acknowledge that players practicing serious game training have an enhanced number of acquired skills concerning traditionally trained users. A study conducted by Qin et al., (2010), indicates that game-based interfaces brought upon an increase in their interests in learning. Representing a useful training technology for health professionals and patients while confirming that serious gaming technology represents a valuable training technology for healthcare professions and health-related education. This thesis aims to create a serious game that facilitates acquiring knowledge through its motivational capacities, as well as for its pedagogical principles, which include interactivity, repetition, continuous feedback, and user-centered approaches (Murphy, 2017).

2.2.3 Motivations from serious games

A significant factor in education is the time allowed for the learning process, according to Hamstra et al., (2013). A longer time is associated with better learning outcomes; hence players using these serious games would still enjoy the gaming experience while learning for hours (Eichenbaum et al. 2014).

David Drummond et al. (2017) stated that producing a motivating serious game demands the developer be involved in the motivation of the end-users. Following the self-determination approach of Deci and Ryan (2000), there are three types of learners that we should consider: extrinsically motivated, amotivated, and intrinsically motivated learners. According to Drummond et al. (2017), serious games might be interesting for extrinsically
motivated learners, considering the learning process as an unpleasant but vital step to reach desirable outcomes, while allowing them to experiment with enjoyable outcomes while learning. He also says that “serious games combine the enjoyment of this future outcome made virtually present with the learning activity” (Drummond et al. 2017).

This may explain medical students’ enthusiasm for simulation games in which they play the role of medical doctors. The association with their final objective—practicing as a doctor—is promising to motivate these students to learn. Game developers should consider this principle of “convergence of motivations” vital if they want their product to be motivating from their learners.

To further analyse motivation as a key factor, it is vital to embrace cognitive science’s four main pillars of learning: active learning, attention, feedback, and consolidation. Firstly, learners and players should stay alert throughout the learning process. Users need to be motivated enough to play serious games with the purpose of accessing the learning content. A serious game cannot be finalised without the intervention of its user. In serious games, the level of attentiveness is the effect of three elements: the game’s graphic and sound environment, the challenge proposed, and the player’s motivation. Learning happens by minimizing the difference between the expected and actual outcomes through the feedback received. According to McGaugh, (2000), consolidation is the process that enables the memory to build upon the first steps when acquiring a skill such as reading or swimming. It requires the learner to stay focused to allow the brain to perform the task faster and unconsciously.

According to Drummond et al. (2017), these four pillars are fundamental in ensuring thorough involvement in serious games.

2.2.4 Evaluating serious games in education

A variety of purposes (educational training, skill, awareness-raising, science, and research, etc.) and the various types of gameplays (simulation, role-playing, strategy, adventure, etc.), all suggest that the evaluation of these games must be different, even if following a methodological framework.

One clear example is “Virtual University,” a serious game that simulates administration of a university system. As an interactive tool that utilized video game technologies, it was successful in motivating learners intrinsically and recreating learning situations close to reality. It also offered a substantial educational advantage as it generates cognitive or socio-cognitive conflicts, development of knowledge, and transfer of skills.

Re-mission (2006), a serious game developed for young cancer patients, is a stellar example of successful integration of these theoretical factors. Players control a humanoid nanobot in a third-person shooter format, with various missions to destroy different types of cancer at a cellular level. Most of the patients were likely to be extrinsically motivated learners with a profound hope to reach a very desirable outcome - being rid of their cancer. Researchers witnessed that playing the game led to more consistent adherence to chemotherapy and other treatmentsKim, (2018). This is an example of how serious games could preserve both enjoyment and learning effectiveness while imbibing better learning approach and knowledge and treatment adherence. A study conducted by Qin, et al. (2010), indicates that game-based interfaces brought upon an increase in their interests in learning, representing a useful training technology for health professionals and patients while confirming that serious gaming technology represents a useful training technology for healthcare professions and health-related education. However, while evaluating serious games, conventional metrics need to be adjusted to digital games and complement the evaluation of the gameplay experience, using, for instance, Csikszentmihalyi’s flow theory (2009). Focus groups think-aloud play, questionnaires, semi-structured interviews, user observation, and a few more have all been used successfully in evaluation studies, especially in various stages like alpha, beta, and gamma testing, where user involvement is gradually more and more essential.
2.3 Canonical examples

2.3.1 Plague Inc. (2012)

Plague Inc. is a high strategy simulation game where users discover and learn how viral infections work by attempting to grow and control the global distribution of a dangerous pathogen. Players are tasked with balancing infectiousness, lethality, and visibility as they aim to infect and kill as many people as possible before humanity deploys a cure.

In the game, players can utilize various types of pathogens like bacteria, viruses, parasites, prions, fungi, and Nano-viruses. The game’s entertainment component comes from its inclusion of novel plagues such as the mind-controlling Neurax Worm, a Necroa Virus plague that gives rise to zombies, a vampire-themed Shadow Plague.

The game serves as an educational tool to raise awareness about how the virus can spread globally as well as effective countermeasures against it. However, some players have used the game as a scientific model, which has led to sensationalizing of more significant real-world issues.

The interface of the game consists principally of a world map. Users receive visual feedback on the map through a change in colours, depending on the level of success in controlling the pandemic. Red is an indicator of infection, while black indicates fatalities. One of the most distinctive traits of the game is the degree of engagement - it captures the player’s attention with its imaginative approach to educative gameplay, Robinson et al. (2018) suggest that with the combination of utilizing such data with simulated modelling of disease spread, and can be beneficial for students to gain a greater understanding of the importance of accurately conceptualizing management and mitigation models based on pandemics.

2.3.2 The Great Flu (2009)

In the game, players act as the Head of the World Pandemic Control throughout the outbreak of Gamer’s Flu, a highly contagious disease. It is a real-life simulation game based on models concerning population density, travel movements. As the game proceeds, the player is required to take actions such as dispensing medication and face masks, closing schools and airports, sending research teams in an attempt to control and ultimately defeat the virus. The game starts with a viral infection which rapidly develops into an epidemic or pandemic. Players are unable to stop the outbreak but are capable of controlling the virus and keeping the impact as low as possible.
The Great Flu, therefore, creates insight and awareness of the impact a pandemic will have. It creates understanding and respect for the difficult choices others have to make to control or prevent such scenarios. The game presents some weaknesses, such as there is no built-in tutorial, and it takes some time before the virus even appears, leaving the player waiting for the initial period. The interface shows unnecessary graphics that get in the way of the game, making it difficult to traverse the world. Also, the map does not fit the screen, making it difficult to handle. Another weakness is that the player does not learn how the virus actually spreads or how their actions affect it. Some players complain that reveals limited information, and the game conclusively relies on the multimedia embedded within it to educate. While the game does offer motivations for people to get knowledge in the media, the gameplay often makes players overlook it and concentrate primarily on winning. Sadly, with so few feedback the game provides only limited understanding of epidemics.

![Image](https://www.fastcompany.com/1332286/great-flu-video-game-turns-pandemic-pastime)

**2.3.3 Stop the Spread! e-Bug Junior (2008)**

Stop the Spread was one of the many pilot games developed to teach learning outcomes by the e-Bug Project, an initiative spearheaded by Public Health England's (PHE) Primary Care Unit. With respiratory hygiene and antibiotic resistance in European children being two of e-Bug's major concerns, Stop the Spread's aim is to educate a junior age group (9-12 years) that is directly at risk from these two factors.

The game's screen is a bird's eye view of a simple playground with 36 moving children, out of which three are highlighted green, indicating they are infected. As each level begins, children move about the playground freely, and the infected children begin to sneeze at fixed intervals (5-7 seconds.) As a warning, the green children turn red from a second before they sneeze to a second after sneezing. A sneeze in the proximity of a non-infected child turns the latter green. The game ends when all 36 children turn green, and players receive higher scores if their actions helped delay the spread.

In the first level, players must move tissues (using the mouse) near sneezing children to prevent them from spreading the infection. They must then quickly dispose of the tissue in the bin at the bottom right of the screen, and press on a button in the center to receive a fresh tissue. In the second level, players must use tissues as before, but now also have the option of vaccinating any three children during the level, using the syringe icon, which turns them purple and makes them immune to infection. In the third level, players must vaccinate 10 children in advance and follow the same objectives as before.

Yardley et al.; (2011) conducted a study that showed an intervention using online health tools could lead to a rise in hand-washing. The e-Bug Project has cleverly used these pilot games
to pique the curiosities of these players, and to urge them to explore e-Bugs comprehensive educational archives on microbes, infections, hygiene and antibiotic use. The study, indicating that serious games did not just provide good edutainment, but that they may have also contributed to a rise in knowledge, leading to a successful convergence of motivations for designer and target audience (Young et al., 2015). The major drawback of Stop the Spread was that like all of e-Bug's games, it is designed using Flash, making it excruciatingly slow on some devices and totally incompatible with the latest ones.

2.3.3 Pandemic (2008)

Pandemic is a board game in which users work together to defend humanity from four world-devouring viruses. The game embraces strategic thinking, a healthy dose of variability for each play session, emergent complexity, cooperative play, and collaborative communication design. The goal in Pandemic is to work together to slow the spread of diseases around the planet and to cure them before they get out of hand. The components consist of a board/map with 48 cities, player cards, infection cards, cubes representing the diseases, research stations, and a pawn for each player. Each player receives a role card, the dispatcher, the scientist, the medic, the researcher, or the operations expert. These roles give players unique techniques to use during the game. Players can move within cities, share cards, and manage diseases. The key to each turn is realizing when you should treat infections, and when you should try to
get the cards, you need to cure a disease. Players will lose if more than seven outbreaks are happening, if there are no cubes of a disease colour or no more playing cards can be played. One of the game's main characteristics is its perfect marriage of theme and mechanics, making it a thoroughly immersive serious game. There is a genuine sense of rising tension as one plays through; players feel the pressure to make a significant decision as the diseases spread. Furthermore, the different roles force players to be versatile and resourceful in devising effective strategies to win in different playing scenarios. One of the weaknesses of the game is that the roles are not perfectly balanced. Each role presents different challenges and role combinations, and some players might not like the idea of having weaker/less prominent roles. This power imbalance might sour gameplay for certain players focused more on individual involvement than on community action.

2.3.5 Canonical examples conclusion
Most of the games analysed have a pandemic as its central fulcrum, showing a world map to stress how the virus spreads easily, and how local actions can leave a global footprint with widespread repercussions. Each project dispels doubts about the impact serious games can have and highlights their potential as a crucial tool, simultaneously raising the question of how these key aspects can be applied to other areas. Even if these projects do not offer a clear template to follow when micromanaging during a crisis (educating about the symptoms, causes, transmissions and hygienic measures that could raise awareness in preventing pandemics) what they do offer are valuable insights on macro-management; a bird's eye view as to how small scale damage can upset the balance of the whole ecosystem.
3. METHODS
The following thesis aims to approach the design process by using game design research methods as well as quantitative and qualitative techniques to test and evaluate the effect on people's attitudes towards this new global health issue. The use of game-research methods is crucial in defining the principles of design and specifying resources that would help accomplish the game's objectives. The design process will focus on player-centered design; thus, the future players of the game are considered significant sources of information (Ermi and Mäyrä, 2005). The purpose of using a player-centered design process is to implement a framework that visualizes gamification not as a series of rigid unidirectional steps, but as an adaptive and iterative process. Putting people first and at the center of this process helps us understand the user's needs and expectations.

3.1 Project plan

![Figure 6. Project plan by María López.](image)

3.2 Double Diamond
The double diamond design process is a well-known methodology developed by the Design Council in 2007. The same institution defines it as “a simple, graphical way to describe the design process” (Design Council, 2019). The model consists of four stages of the design process: Discover, Define, Develop, and Deliver, which will yield a balance for a creative and explorative process. The double diamond model will help the design process transition from divergent thinking in the open ideation stages onto convergent thinking when distilling the existing design possibilities. In this case, trying to understand the leading target group – young adults – especially those who have a sense of invulnerability to the virus, will require a deeper understanding of their opinions and knowledge on COVID-19, which will help us narrow down the ideation towards a game that could be used as an educational tool.
3.2.1 Discover
In this discovery phase, an idea or user needs is established, in which the designer plays a vital role. The actions taken in this first phase generate innovative outlooks and involve a broad perspective of the issue. This phase is key “in striving to enforce effectiveness; formalization also risks inhibiting innovation and flexibility” (Frishammar, J. & Florén, H. 2010). In these early stages, the quality of work defines the degree of successful innovation and identifies opportunities (Eschberger, T. 2018).

This explorative phase focuses on analysing existing content, articles, photos, and videos of the problem. This preliminary research about the problem domain is vital in becoming familiar with the topic and identifying, anticipating, and preparing for any future issues. An ethnography investigation is the foundation of an online survey that collects information from the target audience to identify key findings and flaws with their level of awareness and knowledge about the pandemic.

3.2.2 Define
In this second part of the double diamond model, it is vital to make sense of the findings found in the first phase, by prioritizing and determining potential steps, integrating knowledge into relevant insights, as well as focusing on the most compelling openings to pursue.

In this defining phase, the needs, problems, and ideas are focused on an end goal. The Define stage also focuses on the context in which the problem or solution resides, as well as the context of the designer itself in undertaking the brief. “In practice, the Define stage ends in a project go-ahead through a corporate level sign–off” (Design Council, 2019). To accomplish the goal of finding the right design, the main tools are a) mapping to make sense of our findings found in the previous phase, b) surveys with the critical audience, and c) use of a cultural probe, which stated by Gaver et al. (1999), is used as an exploration technique. Probes are design-oriented and have an exploratory goal – used for exploring new opportunities rather than for solving known problems. The cultural probes were mixed with game-storming techniques to explore concepts and contexts through participatory design (Ermi and Mäyrä, 2005).

3.2.3 Develop
The development of the project starts with the precise framing of the problem. It is the part of the process where the right design, one that embodies all the characteristics of the objective thanks to the data gathered, is selected. At this stage of the design process, visual design management tools, such as roadmaps and spreadsheets, are essential tools to keep track of every new development. Sketching, rendering & prototyping (both functional and visual) are used to inform internal stakeholders of the progress (Design Council, 2019).

3.1.4 Deliver
The final stage of this design process is the delivery of the game, which means to have a completed version of the design and aesthetics to evoke and serve as a proof of concept. It includes an evaluative process, where prototypes are validated with the final users. These user scenarios are used to highlight weaknesses or strengths in aspects of usability and playability and to connect the gap between designers and users (Ermi and Mäyrä, 2005). This method is utilized when the designer is situated between concept idea creation and concept evaluation. The prototype is built using Sketch and Principle, Sketch allows to design the interface for the game and Principle for its animations such as tapping, dragging or scrolling. Once the hi-fi prototype is produced, the game is tested and analysed to measure the level of education and knowledge generation in its players.
3.3 Human-centered design research

Human-centered design encourages optimistic investigation, providing the researchers with the tools and methods to delve into the unknown and come out with relevant insights from unforeseen places while fostering empathy. It starts with the people we design for and ends with new solutions that are tailor-made to suit their needs. This needs to be done while embracing the fact that the designer does not know where they are headed, and that there is no clear answer or solution. By following the steps of inspiration, ideation, and implementation, a solution will be reached through iterative cycles with simple prototypes that help present ideas as realistic products to the human target audience to get their feedback. This method can provide benefits for the initial steps of the double diamond process, its supporting structure and the discovery and definition, while the design and prototyping will rely more on play-centric design methods. Thus, when setting design mindset for the project, there are many areas to attract inspiration from, the IDEO's “Field Guide to Human-centered Design” (2015), provides this in several points, as it has the creative versatility to provide for divergent thinking and convergent explorations of the information collected.

3.4 Play-Centred design

Play-centric design is a design process in which designers define the aesthetics they want to evoke in the players. Fullerton (2014), which means making players active participants from the early stages of the project. Combined with ideals of a human-centered approach, this allows the design process to be enriched by the research from a synergy of methods. Player-centered game design should ensure that games are easy to learn, fun to play, and emotionally appealing (Fullerton, 2014; Salen and Zimmerman, 2004) while keeping users engaged, which includes allowing them to undergo the state of flow over and over. Mihaly Csikszentmihalyi (1990) defines “flow” as a state of mind in which people are so involved and immersed in an activity that they forget everything else – balancing the challenge of playing a digital game and the abilities that a person holds. “Therefore, while playing games, it is not enough to sit and watch and possibly activate some cognitive schemas. Instead, the player must become an active participant. When successful, this type of participation leads to strong gameplay experiences which can have a particularly powerful hold on the player’s actions and attention”, (Ermi and Mäyrä, 2005).

3.5 Unstructured interviews

At the start of the research phase, the users are approached with unstructured interviews, consisting of open questions to spark discussion and whose responses can be branched out into secondary questions to be used in another survey. The next step is to assimilate responses, find potential participants and confirm suspicions that among young and healthy people, there is this sense of invulnerability about the virus, as stated by (Cherry & Palmore, 2008).

3.6 Secondary Research & Survey

As we move through the inspiration phase, there are moments when there is a need for more context, history, or data — pre-existing works, and evaluating different approaches that already exist. Secondary research, whether done online or by reading books, can allow asking the right questions (IDEO's Secondary Research method, 2015). This is a positive tool that enables designers to generate ideas and nuanced insights. One of the methods used during this phase were Netnographies. Netnography is a particular way to conducting ethnography on the internet and adds specific practices that include locating topics, narrowing data, handling large digital datasets, analysing digitally contextualized data. This qualitative, interpretive research approach allows us to get a better understanding of the target group, their testimonies, and
stories of people who are at high-risk of getting infected, as well as users who have been infec-
ted by the virus and the evidence of experts in the matter.

As a secondary approach to locate the future target audience, a survey is conducted. Accor-
ding to NOAA (Central Services center, 2007), a survey is much more complicated than just
asking a group of people a series of questions to try to solve a problem or better understand
an issue. Instead, a survey is a methodical examination of a population by employing a set
of specific, targeted questions. These questions should possess direct application in solving
a recognized problem or issue. In this survey, rating scales are commonly used to measure
attributes such as satisfaction, level of agreement, and quality. An essential element of a suc-
cessful survey is conveying necessary background information to the respondent through a
lead-in statement. Factors such as the survey objective and goals should be addressed to help
participants understand their purpose for participating. A multiple-choice-questions format,
as well as other categories in which respondents can identify an area outside of the provided
choices, is useful. Overall, it is essential to consider the format of a question (open-ended or
close-ended) according to the type of response it will produce.

3.7 Cultural probes
Cultural probes, as said by Gaver et al. (1999), are used as an exploration technique. Probes
are design-oriented and have an exploratory goal. This quality links probes to concept design
activities, where the goal is often fuzzy, and adjusted through an iterative process. They ask
users to experiment and to make interpretations and explanations of their experiences. Thus,
they offer users’ points of view as bases for enhancing design. Thirdly, the probes are based
on self-documentation. The choice of the probes’ tasks is influenced by the study’s goal, in
this case, seeing the level of awareness, individual responsibility, and measures that users take
during pandemics. The probes’ tasks are then explicitly designed to capture user’s attitudes,
lifestyles, and emotional issues. According to Mattelmäki (2005), four main reasons probes
should be used are: Information, Participation, Inspiration, and Dialogue. Cultural probes
aim to observe different perspectives on personal responsibility and develop further insight
into how users react to social-distancing and the various measures they obey. These cultural
probes are mixed with game-storming techniques to explore contexts and concepts through
participatory design (Ermi and Mäyrä, 2005).

Gamestorming is a technique to gather thoughts and ideas by adding game components and
game-based tasks to brainstorming sessions. It is essential to state that in this scenario, as it is
defined as using participants in design games that allow design activities to discuss existing
realities, research future visions. It is also about creating a game world to explore challenges
and improve collaboration with users, by imagining, exploring, and creating possible worlds.
This activity aims to generate ideas as design, with tasks that consist of creating mind-maps
and user scenarios.

3.8 Prototyping & Sketching
Two stages of prototyping are used in the project: lo-fi and hi-fi. The first, lo-fi, consists of
rapid paper prototyping. The use of paper prototypes allows users to participate in the design
process and share different ideas without the use of any programming knowledge and ensu-
ring active collaboration in the design process of the game (Fullerton, 2014). According to
(Sydner 2003), prototyping allows rapid feedback from the future end-users of the game. Mo-
reover, according to Kapp, 2014, and Kim, (2015), rapid prototyping is used to look at how the
player reacts to the content and challenges, as well as their interactions in these prototypes.
Qualitative data, such as sketches and observations, are used as the primary source to distin-
guish the interaction of the player from the different emotions taking part of the playing ex-
perience. To achieve a hi-fi prototype, several prototyping tools and animations can be used. The testing for playful experiences in the hi-fi prototype can be developed using Wizard of Oz techniques, using tools like Sketch and Principle which will allow creating the animations of the game to test it with participants later and send the file to some of them to test it online while the designer will be present on a Skype session. The aesthetics of the game need to be approached carefully as they could change the meaning of the game (Kim, 2015).

The focus of these prototypes is playability - a term used in the design and analysis of video games that describe the quality of a video game in terms of its rules, mechanics, goals, and design. It refers to all the experiences that a player may feel when interacting with a game system. Sometimes, the experience is related to the different ways of interaction among players. It is also affected by the quality of the storyline, responsiveness, pace, usability, the possibilities to customize it, control, the intricacy, intensity of interaction, and strategy, and the degree of realism and the quality of graphics and sound (Voida and Greenberg 2011).

3.9 Playtesting

Two main ways should be employed to assess if the game has transferred knowledge, or if it changed their knowledge about the issue. The first are embedded parameters that evaluate the player’s activities without them knowing, such as scenarios, which helps identify ideal participants prior to playing the game and to classify them into extrinsically motivated, amotivated, and intrinsically motivated learners. The designer is present during these sessions as it is fundamental to apply Wizard of Oz method (Hanington & Martin 2012), where the users work under the presumption that they are dealing with an actual working prototype, but the designer manages the real work. This user experience of the product is a far better alternative than developing a costly prototype.

The second are surveys that users fill before and after they have played the game. Pre and post surveys are given to participants and are designed to measure attitudes towards behavioural change and awareness. The scales and questions are adapted from Lavender's Batson's scale (1997), in this case is tailored to our research topic. The scale is divided from strongly agree to strongly disagree, very sympathetic to not sympathetic, and knowledgeable to not knowledgeable, among others. Once both surveys are completed, the answers’ ratio is calculated to see if there have been significant changes in player’s attitudes, conscious awareness towards the problem of the novel coronavirus, and its risks.
4. DESIGN PROCESS
4.1 Discover
4.1.1 Preliminary overview
If we follow the steps and learnings from Pedersen's "design before design" (2015), it is fundamental to research about the problem domain and the opinion of citizens that have been severely affected by the pandemic. Moreover, the reason to use this channel is only to build a common contextual basis between the researcher and the people who were to be interviewed. The study of existing projects was also crucial in this first stage of the design process, to better understand how serious games, gamification, and player-centric design have been used in sectors such as healthcare, as educational tools. The use of concept mapping was also essential as a sense-making tool that connects a large number of ideas and can help visualize the complexities of systems while making connections. Researching this information in advance allowed for better preparation and selection of the questions used for the survey. The research was focused on facilitating open discussion and to lead to secondary talking points while interviewing people.

4.1.2 Unstructured Interviews
Unstructured interviews can produce meaningful data through questions and developing a genuine insight into a person's opinion as well as their perception of the situation and their feelings about it. This was a flexible method of interviewing that nurtured a conversational approach rather than pre-planned interview questions. The interviews were improvised interviews with young people aged 18-29, who were self-isolating during the pandemic, a nurse who was treating COVID-19 patients, and a person with diabetes who was self-isolating in Spain. From the unstructured interview with the nurse, the designer gained an insider's view on how prepared the healthcare system is to tackle the increasing number of cases as well as how knowledgeable young adults are about the prevention measures and their level of awareness towards the virus. With respect to the person who was at high risk (diabetic), the designer was able to gain a unique idea about how a person at high-risk views the virus, the degree of change in their routines due to a grave threat to their health, as well as their level of awareness (Appendix 2). The results from the unstructured interview were mapped with different colours to visualize, organize thematics and meaningful data about participant’s opinions regarding the problem domain, (Figure 7).
4.1.3 Secondary Research & Netnography
Secondary search IDEO (2015) was utilized to get other sources to complement the information learned from the interviews and better comprehend some of the concepts that came up. Some netnography was used to understand the testimonies of medical and healthcare workers that are facing the stress of the coronavirus outbreak. During this netnography, several videos and testimonies of people facing the consequences of COVID-19 were analysed, especially the testimonies of doctors and nurses, as well as journalistic records about the consequences of not following the guidelines and restrictions. Sources such as YouTube, Reddit, and Twitter were used to source testimonies online, which helped form a bigger picture of how serious the virus is. The secondary research and netnography were considered excellent tools in the design process to better understand the risk and consequences of not practicing and following guidelines. This helped the designer gain a holistic understanding of the testimonies of people who were at high as well as low risk. An important finding was that even physically fit, athletic adults that did not have a family history of complications or present underlying health conditions were severely affected by contracting the virus when they ignored imposed restrictions.

4.1.4 Survey
The main objective of this general online survey was first to confirm the hypothesis that among young and healthy people, there is this sense of invulnerability about the virus. The objective of this online survey is to approach the key audience (young and healthy adults between 18–40 years-old) to identify key findings, their level of awareness and knowledge about the pandemic and if it is true that people are facing an overload of conflicting information about the virus through multiple channels. The questions were divided into four main categories: personal information, personal behaviour, perception of others and knowledge (if they get anxious and watch the news, if they have been exposed to them, knowledge about the virus and guidelines to prevent it, their grasp on hygienic measures, individual responsibility and collective responsibility), Appendix 2.

4.1.5 Insights from the survey
The survey was sent to 22 people from India, Spain, Belgium, Guatemala, Sweden, and Italy. Most of the participants were between the ages of 18–40, and the survey was sent to most participants through SUNET. Six of them were made into a paper survey for participants who lived in the same apartment complex. With regards to following guidelines, one participant stated: “As an educated citizen with a social conscience, I consider it my duty and essential responsibility to play my little part in minimising what damage CoVid can do. I recognize that by going out I’m not only putting my own health at risk, but also greatly endangering the health of my grandmother.” Another said that, “a person with common sense would not do that, for everyone’s safety.” Some responses offered differing perspectives, such as, “I need to go out to work out. I know it’s bad, but I have to,” and “I feel stressed at home, so I walk the dog more than usual”.

The survey offered two contrasting behavioural tendencies which made for key data while designing the game. Even if some seemed to be informed about the risk and consequences of COVID-19, others were still not sure about some preventive measures. When asked how much time COVID-19 can survive on hard surfaces, some responded, “I’m not sure, I heard somewhere it was for 2 days, but the other day I heard 2 weeks.” When asked what should be the percentage of alcohol in a hand sanitizer to prevent the contagion, some of them said, “I’m not sure”. From the set of questions presented in the survey, we found out there were mostly two kinds of participants: a) Those who were seriously conscientious and b) participants that were not worried about the virus or were unsure about the effectiveness of preventive measures. The answers in this section also allowed us to understand the influence of information
overload on knowledge level. To sum up, finding different perceptions and types of opinions allowed us to target future participants who would receive cultural probes, especially those who did not follow the guidelines. Moreover, mapping was an excellent tool to visualize, organize and analyze information, create connections between the different insights. In this case, through colours, the designer classified the different types of behaviours, pink for those who did not consider the virus a serious threat and orange the opposite response (Figure 8).

4.1.6 Conclusions
Applying structured interviews and a survey complemented with IDEO’s secondary research method (2015), were useful in the development of this stage in the design process. Even though not all the questions were probably discussed, the freedom of open discussion allowed participants to open up about their opinions and measures that individuals take during the pandemic to mitigate their chances of contracting the disease. Even if each discussion was different from the next one, several common points led to valuable insight about their experiences with quarantine.

Later on, the secondary research was fundamental in putting together all the parts gathered from the interviews, researching guideline measures, and the problems that healthcare workers are facing globally. The use of the survey was essential in getting a deeper understanding of the main target audience’s mindset (young and healthy between 18-40 years old), who are English speakers. It was also fundamental in offering behavioural insights regarding how serious they think the virus is, and how they are following the guidelines and recommendations from their government and health institutions such as WHO. 70% of the participants considered COVID-19 to be a severe threat, whereas 30% stated that the virus was not a serious threat. When asking about prevention measures and hygienic guidelines 70% of the participants were following the guidelines recommended by the WHO and other governmental institutions; however, some seemed to display a lack of clarity when it came to finer details. For instance, a few participants were asked what percentage of alcohol a hand sanitizer should have, and they answered with “none, it’s irrelevant”.

![Figure 8. Mapping survey results.](image-url)
4.2 Define

4.2.1. Cultural Probe

The cultural probes were designed with open-ended task for participants to express any concern about the topic (Mullane, 2014). Moreover, it was fundamental to clarify questions about the target group and audience such as: Is it true that there is still a sense of invulnerability towards the virus? How educated are they when it comes to the virus and the preventive measures? Are they rigidly following the guidelines that institutions and the government are placing on individuals? If not, what liberties are they taking?

In this scenario, six participants, aged 22-30, from countries like Spain, India and Sweden, were asked to work with the cultural probe for a maximum of four days. As we find ourselves in atypical circumstances of social-distancing, cultural probes were adapted to two different versions: digital and physical.

Mattelmäki (2005), states that probes are used to empower the designer and the users to express their interpretations and creativity on the subject. The tasks were designed in a way that they could be attempted ambiguously; this was to give users the freedom to choose the direction that they felt comfortable with. These cultural probes attempted to foster creativity through challenge and tasks (Mullane, 2014). The five different tasks were created in keeping in mind - motivation, the need to gather information, and the need to nurture dialogue with the participants. The tasks consisted of: a small survey, gamestorming activities, card sorting, a “before and after” map and a diary.

4.2.1.1 Mini survey

Unlike the more generic, fluid first survey, the mini-survey narrowed its focus to engaging the target demographic and acquiring data crucial to the thesis. For instance, the initial survey had questions asking their opinions about the effectiveness of government imposed lockdowns/restrictions, the mini-survey asked participants how nervous they personally felt every time they had to go out for essential tasks. The mini-survey revealed that participants considered themselves moderately knowledgeable about the virus, but were uncertain or hesitant when answering questions related to effective prevention measures. When asked about minimum safe distance they needed to maintain with another person, some answered “two metres, right?” When asked how they could tell if someone has COVID-19, some stated “I do not know.” Most of them also declared that they do not consider the virus to be a serious threat. One of the participants stated that “the epidemic seems a serious topic, but I’m young and I want to live a life without fear.” The only exception to this trend was the person at high-risk for
diabetes, who stressed that “it spreads at an alarming rate and incubates for two weeks before showing symptoms, hence increasing the number of unaware carriers.”

The answers in this section allowed an understanding on what level COVID-19 is affecting their lives, how people view the importance of taking individual responsibility to mitigate the spread of the virus and their level of knowledge, while simultaneously introducing participants to the contents of the probe.

4.2.1.2 Gamestorming & Cardsorting

The results from gamstorming activities were varied, but most participants had a clear idea that lungs were the parts where the virus causes the most damage. Interestingly, many marked the lungs and eyes as the parts most affected by the virus. Hands and nose were the parts chosen as the likeliest to aid transmission.

The second activity of the digital cultural probe consisted of a set of slides, on which participants were asked to draw lines, move stickers and write using a PowerPoint. There were two tasks that participants were asked to accomplish - the first one consisted of a puzzle game, where the process of washing hands was broken into steps. Each of these steps was illustrated on a different slide, and the slides were put in random chronology. Participants were required to find the right order. Additionally, two of these steps were left blank - type of soap used and estimated time of washing.

Surprisingly, some of the participants were unable to find the right order of the slides, and some wrote in the parts that were missing that they wash their hands with normal soap, at least 10 to 15 seconds. Once again, the participant that displayed a higher level of awareness about the steps was the person who was self-isolating because of diabetes. The results showed a direct relationship between the risk of exposure and the level of awareness in a person (Figure 10).

In the second activity, participants were given two related contexts - a supermarket queue and a set of characters with a story/scenario. During these scenario-based tasks, participants had to rearrange and assign stickers to the different characters, draw line, write or doodle. Some of the stickers included “mask”, “gloves”, “social distancing,” “quarantine,” among others.

However, most of the participants did not move the characters; rather, they just placed the stickers and wrote what each person needed to be protected from the virus.

Cardsorting was an exercise inside a word document with images and a grid where participants had to fill in words. In the physical version, it was presented in an envelope. This task consisted of asking participants to look at eighteen different images depicting various types of social interactions (ranging from as intimate as hugging to as distant as video calling) and human behavior (coughing, conversing on public transport, and more.) They were then asked to group existing words with an image they felt correlated to, or they were asked to come up with their own words for the images. Some of the provided words were: So-
cial distancing, Physical distancing, Isolation, Quarantine, Incubation period, asymptomatic, community spread. Some participants came up with new words, and others used the given words.

Most participants did not write accurate words, but it was interesting to note how this method can lead to discovering how the domain knowledge of a target audience is structured. (Figure 11 shows the results and words they chose for the pictures given). The chosen images were carefully selected and open to interpretation to provoke them to write different words besides the ones they were given. (Table 1, shows that most of the users made up different words or repeated the same without seeing what the other participants wrote).

The results from the table display what people perceive and think. In this sense, card sorting was an excellent way to reinforce existing associations and create new terminologies, categories, and relationships. Moreover, drawing and naming pieces produced very different results; some wrote words that were not related to COVID-19, as can be seen in participant 4’s contribution to image eight as “Love.” They showed different understandings of the prevention measures and the categories.

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**Table 1. Cardsorting table.**

<table>
<thead>
<tr>
<th></th>
<th>P1</th>
<th>P2</th>
<th>P3</th>
<th>P4</th>
<th>P5</th>
<th>P6</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Irresponsible</td>
<td>Bad</td>
<td>Community spread</td>
<td>Touch</td>
<td>Community spread</td>
<td>Infected</td>
</tr>
<tr>
<td>2</td>
<td>High risk</td>
<td>Incubation period</td>
<td>Beware with surfaces</td>
<td>Superspreader</td>
<td>Do not touch</td>
<td>Asymptomatic</td>
</tr>
<tr>
<td>3</td>
<td>Social distancing</td>
<td>Social distancing</td>
<td>Social distancing</td>
<td>Social distancing</td>
<td>Isolation</td>
<td>No visitors</td>
</tr>
<tr>
<td>4</td>
<td>Not social distancing</td>
<td>Infected</td>
<td>Community spread</td>
<td>Friends</td>
<td>Community spread</td>
<td>No distancing</td>
</tr>
<tr>
<td>5</td>
<td>Irresponsible</td>
<td>Superspreader</td>
<td>Quarantine</td>
<td>Infected</td>
<td>Superspreader</td>
<td>Symptoms</td>
</tr>
<tr>
<td>6</td>
<td>Cleaning phone before using</td>
<td>Social-distancing</td>
<td>Screening</td>
<td>Contacting friends</td>
<td>Social-distancing</td>
<td>Isolated</td>
</tr>
<tr>
<td>7</td>
<td>Not social distancing</td>
<td>Physical distancing</td>
<td>Community spread</td>
<td>Post-lock-down</td>
<td>Community spread</td>
<td>Community spread</td>
</tr>
<tr>
<td>8</td>
<td>Not doing that</td>
<td>Physical distancing needed</td>
<td>Risk</td>
<td>Love</td>
<td>Community spread</td>
<td>Superspreader</td>
</tr>
<tr>
<td>9</td>
<td>Infected</td>
<td>Symptoms</td>
<td>Quarantine</td>
<td>Infected</td>
<td>Quarantine</td>
<td>Quarantine</td>
</tr>
</tbody>
</table>

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Figure 11. Cardsorting. Images from: Unsplash.
4.2.1.3 Map before and after
In this task, participants were asked to draw their journey when they have to go out for essentials. This includes specifying how much time they spend outside now, compared to when they were not following restrictions. They were also asked to define how many people they encounter during their journey and what are their thoughts and reflections compared to when there were no restrictions. In the digital cultural probe, this task was presented with a template where users had to draw digitally or place a picture later in the folder. From this task, there were some interesting insights regarding how their outlook on essential tasks (which they earlier used to take for granted) was influenced. One participant stated that “with the gym and public transport shut down as well as police presence on the street, my only physical exercise is walking up and down a 2 meter stretch outside my house. My social interactions have dropped to zero. Sometimes I see my cousin walk his dog, and we talk for not more than ten minutes.” Another highlighted, “when I walk the dog people observe me from the balcony when they see me talking with another owner, they stare so much that I feel intimidated,” or “when I go out these days for essentials it feels weird. I try to avoid people” Some others stated that they have not been out at all since the lockdown; therefore, their map was blank (Figure 12).

![Figure 12. Map before and after.](image)

4.2.1.4 Diary
In this task, users were given a dairy and were asked to describe their daily routine during quarantine, using whichever mediums they liked. If they went out, they also had to describe their preparations before stepping out, as well as their experience while being out (the people they encounter, the journey, thoughts, and reflections), as well as the measures they follow when they return.

The last task consisted of a personification exercise, in which each participant had to imagine the day of a person who is at high risk. This could include, for instance, a person with diabetes, a doctor, a nurse, a person who lives with older people, a cashier at a supermarket, or someone who has a weak immune system, or lung disease. Some participants were generously descriptive and gave interesting insights into rituals or procedures they use before and after coming home. Some stated, “before leaving home, I wash my hands, put on my mask and gloves. Once away from home, the experience is rare; since you see many people in fear and we all try to take precautions following the parameters set by the government.”

The person with diabetes wrote, “due to the high risk that there is in my country and my illness, I cannot go outside, so the one that comes out is my husband. We try to get him out well protected because here the pandemic has not been well controlled and it is very dangerous”. Others described the measures they took before walking their dogs - “I had to take the dogs for a walk, so before leaving, I put on my mask and gloves and grabbed a bottle of water. We walked for a while (the police were looking at me suspiciously).
Other participants decided to write about TV shows and films they watched. In the personification exercise, it was intriguing to see participants putting themselves in the shoes of people at high risk. Some of them wrote, “a day as a supermarket or pharmacist employee must be uncertain, and fear must be present since many of the employees do not have adequate protective equipment to carry out the activity. “A person with diabetes must be concerned about the virus, and worried, maybe they don’t go out at all.”

The results of the diaries were subjective, and the wide spectrum of scenarios in different cultures and in environments with varying levels of risk (say, high-risk Spain versus moderate-risk Sweden) made for intriguing analysis. Using user-scenario games could be an interesting approach for the conceptualization of the game, which would allow users to be more empathetic while learning about the risks and measures that others need to follow to mitigate the spread of the virus.

4.2.1.5 Results

Despite the fact that they did not provide accurate results, Cultural Probes offered explorative behavioral insights and an understanding of the participants’ level of awareness. Simultaneously the diary also helped confirm how a significant number of young and healthy adults are neglecting the gravity of the threat. Using games in the probes and scenarios allowed participants to contribute exploratory research and insights into our users’ real-world and behaviour. To comprehend the vast amount of information that the designer gathered. Affinity diagrams were used as a sensemaking tool to visualize the information collected in the folders. The green colour indicates positive behaviours and orange, negative ones, (Figure 13).

One of the participants wrote, “these activities that I thought were silly in the first place, actually make me think a lot about the measures that I take daily.” She later explained that she sees these activities as a way of making individuals self-reflect about their actions. The diaries were also an interesting gateway to approaching different user scenarios and to see how they think and act during the pandemic. It was particularly interesting to observe the point of view of the diabetic participant who is self-isolating due to being at high-risk. Even if some parti-
Participants did not state explicitly if they were going out, they decided to describe what they were watching on TV gave us enough reason to assume self-isolation on their part. Hence, probes were an excellent exploratory tool to get a better understanding of future users’ attitudes. However, when comparing digital cultural probes to the physical, cultural probes, there were slight differences. Even though both cultural probes allowed participants to express themselves through sketches or drawings, physical, cultural probes gave the participant more freedom and ease compared to users who had to use the digital medium.

4.3 Develop
4.3.1 Sketch and Prototyping low-fi
To do low-fi prototyping for a game and to create a solid concept confirmation, it is crucial to test potential approaches to game narratives and experiences. According to Buxton (2007), a sketch is something quick, inexpensive, disposable, and suggestive rather than confirming (Buxton, 2007). The prototypes were handmade with papers and pens, and pictures. The focus of these prototypes was usability and playability of the different interfaces of the future game (Snyder, 2003). Players needed to have an engaging experience to test the internal validity; therefore, no real content was added at this point. The prototypes consisted of five different micro-games that represent different “items” in the avatar’s life, and two different versions to relate to the avatar.

Two different gameplay experiences were prototyped to observe the engagement of the user and how they connected with the avatar, and if they felt they gained knowledge. The first prototype was designed for players to have an emotional connection with the avatar. As they won or lost points, the avatar’s facial expression transitioned between “feeling ill,” “confused,” and “feeling safe.” The different items that kept the avatar alive were selected in random order. The second prototype was a board game where the player had to go through all items in the same order they were placed in to finish the game. The board game contained a different version of an avatar, from the perspective of the virus.

4.3.2 Player testing
Player testing is fundamental for serious games to find the right balance between a serious educational game and a fun educational game. There are two different types of challenges in serious games: internal and external validity. The prototypes for “Stay at Home” tested the game’s internal validity and how its players engaged, evolved trust in the game, broke the rules, or navigated the obstacles. To test external validity, Immune was also created, to see how players linked the game to the real world. The games were tested with six participants aged 20-33. However, due to COVID-19, it was clear that the game needed to be tested with one participant at a time; thus, following the guidelines imposed by The Public Health Agency of Sweden, participants were people who live in the same apartment complex.

a) Immune
Immune was prototyped to test how users will relate to a board-game idea in which to complete the game, players had to go through all the items in the same order of placement. In the game, users had a different character on screen, a Coronavirus avatar. Participants won or lost points according to their performance in each game. If they lost, the Corona avatar grew bigger. The goal was that with small interactions, the designer could teach participants about prevention measures to mitigate the spread of the virus and introduce educational facts. The game could be played in less than twenty minutes and offered basic knowledge about prevention and recommended guidelines such as washing your hands or putting gloves and masks correctly. Most of the players claimed that the game was monotonous and did not enjoy test-
ting it, as it had continuous information and too much text which interrupted the gameplay. Furthermore, it barely offered feedback for participants, which did not make it challenging enough. They did not understand the interactions with the Corona avatar and pointed out that they viewed the use of an avatar of a virus for such a sensitive topic as inappropriate. One of the participants stated, “I think it is confusing to relate to an avatar that is a virus and take the game from its perspective; it is simply not serious.”

**Figure 14. Immune.**

**b) Stay at Home**
Stay at Home was prototyped to examine the player’s engagement with its avatar. The game was formed with micro-interactions, and it took players twenty-five minutes to play all the games. Participants were asked to approach a table where all the games were displayed and explained and had the opportunity to stop or selectively play any of the micro-game (Hygiene measures, body scan, word sorting, map, and memory surfaces). Participants pointed out that they enjoyed the game experience, but the educational aspect was missing in some parts of the micro-game, such as “map item” or “memory-game.” They asked for more information about the results they were having and stories with the character and personification elements. Moreover, in bodyscan, they did not enjoy the quiz option and found it boring. Players also suggested that they were most eager to get back to the game and chose to skip reading the screen with informational feedback regarding guidelines and measures that the avatar was showing.

**Figure 15. Stay at home.**

### 4.3.3 Game scenarios
The game scenarios were created based on the feedback from the lo-fi prototypes and the variety of players. The scenarios were later used to identify players being tested in the hi-fi prototype and to help design new interactions and guidelines to prioritize the learning objectives and aspects of playability. Three different scenarios were showed and based on the theory
of Deci and Ryan (2000), three types of learners that we should take into consideration were identified: the extrinsically motivated, the amotivated, and the intrinsically motivated. The first scenario represented a player that obeyed the instructions thoughtfully during the game and followed its recommendations. The second scenario presented a participant that wants to break the rules, and finish the game as quickly as possible. The third scenario included a player that does not care about the game but is willing to play it due to its content.

**Scenario 1 (extrinsically motivated)**
Esther is a nursing student and lives with her grandma, who is at high risk for contracting COVID-19. She has been informed about the pandemic since the beginning of the outbreak. She carefully follows all the guidelines that minimize the spread of the virus. When looking for information on how she could protect some of her friends who do not care about the guidelines to follow, she stumbled upon “Stay at Home”. Esther read the description of the game, downloaded it, and started playing on her tablet. She then realized that she needed to share it with her close friends and everyone on Facebook.

**Scenario 2 (amotivated)**
Irene is a student whose life has been affected by the lockdown, but due to the information overload, she is confused about which guidelines she should follow. She has an iPad, and when bored at home, she likes playing micro-games or using Duolingo, a language learning app. She came across “Stay at Home” and decided to play, but she did not have the time to read the game description because she had a Zoom meeting to attend. Irene wasn’t sure if it would be a good approach to gaining the right insight and information about such a sensitive topic, so she removed the game later.

**Scenario 3 (intrinsically motivated)**
Laura has been watching the news with her daughter about COVID-19. She was curious about which measures they should follow when she found “Stay at Home.” She played online for a couple of days, read almost all the instructions and information provided to save the avatar. After playing, she realized she has a clearer outlook on crucial information on the pandemic but does not trust the game completely. Right before removing the game, she decided to share it on Instagram.

**4.4 Deliver**
**4.4.1. Concept**
In this section, the designer explains, in detail, the creation of Stay at Home as well as the content, rules and paths of the game. Player testing and showing user scenarios to the users are two key steps to specify the direction the game should take. The playtesting scenario proved that the strongest game and avatar were the ones that changed her feelings based on the score. All the feedback needed to be taken into consideration when designing the game; the micro-games and the menu section were designed by analysing user interactions and preferences during the low-fi playtesting session. The game was divided into five micro-games that consisted of: Hygienic Measures, Body Scan, Stay Safe, Personification and Corona Sorting. When the users play the different elements, the avatar starts feeling better or sick depending on the points and performance in the game. The “Hygiene Measures” was formed by organizing the different steps involved in how to wash your hands, correctly.
Body scan included an infographic of the human body in which participants had to point out the most affected parts by the virus and areas where the first symptoms start to show up. Stay safe include two main sections, the first a quiz of MythBusters. The forth personification consisted of players putting in the shoes on the character of someone who lives with a high-risk
person. And finally corona sorting, in which participants have to associate the meaning of words such as “social distancing,” “asymptomatic,” with the right picture to understand what does these words mean.

To get high scores, save the avatar, players need to complete the different microgames. When each of the microgames has been completed, participants gain a maximum score of 40 points in each section. If they sum up a score of 150 they can move to the next level in which the difficulty rises and new options are unlocked. The game is designed so users can play around 10 or 15 minutes to stop it and continue playing later. Thus, it is a game that is meant to be played in a short time.

This hi-fi prototype took into consideration two main areas to understand how players described the game. The first, the aesthetics of the game, were designed to be playful and simultaneously show a colour scheme with icons and illustrations similar to the one used in the cultural probes and the playtesting lo-fi prototype.

The idea was to conceptualize a design sensibility that could overcome certain inhibitions and negative stereotypes associated with serious games, by engaging the player with its strong playability and high aesthetic appeal. (Figure 18, shows the design chosen for the game; the

Figure 18. Before and after completing a microgame.
avatar was designed to present herself as confused and feeling unwell when she needs help to understand the different areas and information related to COVID-19. When participants start performing well in the game, the avatar will go from “confused and feeling unwell” to “feeling much better”. The figure also represents game mechanics, which allowed the designer to animate and show the different interactions of the game to the players, such as dragging, tapping, or scrolling. (Figure 17, shows the micro game’s screens of the five different elements presented in the main menu). These were designed with various icons that followed the same colour scheme and style. The main purpose was that when participants finished the game, they could relate to each section by the icon.

Moreover, while designing and developing the different areas of the game, it was fundamental to test the touch and interactions in the screen, drag, tap, touch icons, and achieve better scores. As Charles, (2005) states, it is essential to take into account the user experience, user interfaces, and game experience, which vary in how players engage and interact and play the most to have a better play experience. Thus, these elements were kept in consideration when designing the prototype and were tested with players. Although the primary purpose was to educate players after each game, the user could choose to skip the information screen, which appeared after the completion of each level, and continue playing without disturbing the experience.

4.4.2 Methods playertesting
The evaluation of the game consisted of five participants, ages 23-30. The different participants were chosen to satisfy the diverse types of players, one of these participants was a young nurse who has been working with patients that had COVID-19. Due to enforced restrictions, three of these playtesting scenarios were done with people who live in the same apartment complex and two were conducted online. A borrowed tablet was connected to the computer where the 200 frames of the game were displayed, and as participants were playing the game on the tablet, the designer worked as the “Wizard of Oz.” As the game was animated with Principle, the same application allowed mac users to share the file of the game. The file was sent to both online participants who were mac users and the playtesting was conducted one by one on Skype sessions. In these sessions, more frames of the game were created due to the fact that the designer could not play as the Wizard of Oz (Hannington and Martin, Wizard of Oz, 2012). Both playtesting sessions included a pre and post-test survey. The former consisted of finding scenarios they identify with and answering pre-test questions. The latter involved chatting with the designer about the game and completing a post-test survey sent via SUNET, provided by Malmö University.

The interviews consisted of presenting the three different scenarios that were previously elaborated on and asking them to choose the one they identified with the most, as well as describing why. While the players were playing, they were asked to think out loud and asked questions about how they felt after the game. The questions were regarding if they believed they had learned something different, if they felt more knowledgeable about prevention measures, hygienic measures or if they related to the scenario of putting themselves in the shoes of another person who deals with someone at high risk.
5. MAIN RESULTS
To understand the results of the evaluation and to see if there is a significant knowledge gain, the results were divided into two sections: qualitative results and quantitative results. These sections were meant to cover participants’ interests and help the designer categorize all the data and information received during these playtesting sessions.

5.1 Qualitative Results
During both interviews, before and after, participants seemed to be interested in the game. One of the participants suggested that the game could generate points, which could later be used to donate masks and other medical supplies to doctors and organizations. Three out of five participants suggested that the game did not teach them anything new. However, they pointed out that they did not know the right steps for washing hands or putting on a mask and gloves. “Body Scan” was also useful in helping them distinguish clearly between certain parts of the body that the virus could or could not affect. One participant stated “I have been very confused all this time, because in some places they say you need to wear gloves and not in others,” or “I often feel confused, at this point I don’t know what is truth or not”.

Three out of five participants think this game could be helpful in educating people about prevention measures. Participants indicated that they will trust the game and that its credibility is high due to the fact that it followed guidelines and recommendation by reliable sources such as WHO, Centers for Disease Control and Prevention(CDC), and other medical institutions. However it created a variety of opinions and generated different levels of learning and engagement while playing it. They all seemed to agree that the game was too simple and that sometimes they were focused on playing the different micro-games, which made them reluctant to read the text where the actual information about why their actions where correct or not was displayed. Three out of five stated that they would like to see the points in the main menu instead of at the end of each micro-game. They also conceded that they did not understand the instructions clearly because their eagerness to play the game made them skip reading them.

Four out of five participants suggested that they would play the game again if it was only focused on the item of Personification, as they considered it the most entertaining micro-game due to how smooth the different games were. Five out of five participants agreed that they would like to base the game on Personification and to show more stories about putting themselves in the shoes of someone else while learning about hygienic measures, symptoms and mythbusters. Putting themselves in the shoes of “Sam” in the Personification micro-game, gave them more understanding about the situation that others who take care about people at high risk might be feeling. Four out of five enjoyed the part of the mythbusters and claimed that it was necessary, but at the same it was too simple to play.

The game was accepted by the players and claimed to be useful and necessary for these times. However they missed more interactions such as dragging, swapping or scrolling, and pointed out that the Body Scan game presented some bugs that hindered gameplay. Some pointed out that there was a lot of information when something was correct or incorrect. Four out of five participants could not remember what they had just read at the end of each micro-game.

At the beginning of each playtesting session, participants had to identify themselves with one of the three scenarios created. The designer identified the following: one extrinsically motivated, three amotivated, and one intrinsically motivated. Some participants stated:
“The game was very simple, however I think it could be a good idea to make a version for kids, since it can teach them a lot about prevention measures and the virus itself.”

(Participant 1 extrinsically motivated, 2020)

“I learnt a little bit, for example about the part of how to put the mask or gloves on, which are things that I did not know, or words that I use but I was actually using wrong such as social distancing. I was expecting something more entertaining. Nevertheless, I think it is very necessary to educate people about these things”

(Participant 4 intrinsically motivated, 2020)

“Too much text; makes me lazy to read. I think there is a lack of interactivity. I would add more dragging instead of tapping, but the idea is good and the only part that I’ll play again is Personification, which made everything smoother. I learned something new in the part of the supermarket, however the part of the bodies was too boring and had a lot of bugs. Overall I think it can be very helpful, but I could live without knowing these things.”

(Participant 5 amotivated, 2020)

Figure 19. Playtesting sessions, physically and online.
5.2 Quantitative Results
To test if there has been a gain in knowledge as well as in the level of awareness by the game, measurements were applied. The measurements are regarding changes in areas such as: knowledge on prevention to spreading the virus, hygienic measures, MythBusters, symptoms, and attitude towards information about the virus.

Table 2. Quantitative data

<table>
<thead>
<tr>
<th>Questions</th>
<th>Pre-test Mean</th>
<th>Post-test Mean</th>
<th>% Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. How knowledgeable do you consider yourself about COVID-19?</td>
<td>2.80</td>
<td>3.00</td>
<td>6.89 %</td>
</tr>
<tr>
<td>2. I consider myself to be confused about prevention measures and guidelines</td>
<td>2.80</td>
<td>2.40</td>
<td>15.38 %</td>
</tr>
<tr>
<td>3. How important do you consider it is to check for information in reliable sources such as WHO, CDC, and government and medical institutions</td>
<td>2.60</td>
<td>2.60</td>
<td>0</td>
</tr>
<tr>
<td>4. You consider hygienic measures to be...</td>
<td>2.80</td>
<td>2.80</td>
<td>0</td>
</tr>
<tr>
<td>5. Washing your hands is essential to protect you from the virus?</td>
<td>2.80</td>
<td>3.00</td>
<td>6.89 %</td>
</tr>
<tr>
<td>6. What percentage of alcohol should your hand sanitizer have?</td>
<td>2 out of 5 indicated 70%</td>
<td>4 out of 5 indicated 70%</td>
<td></td>
</tr>
<tr>
<td>7. I wash my hands...</td>
<td></td>
<td>4 out of 5 indicated more</td>
<td></td>
</tr>
<tr>
<td>8. Symptoms of COVID-19 include...</td>
<td></td>
<td>3 out of 5 indicated more</td>
<td></td>
</tr>
<tr>
<td>9. I keep a distance of 1.5 meters or more from others when coughing or sneezing</td>
<td>3.80</td>
<td>3.80</td>
<td>0</td>
</tr>
<tr>
<td>10. If I feel the need to cough or sneeze, I cover my mouth and nose with...</td>
<td>2 out of 5 indicated few</td>
<td>3 out of 5 indicated few</td>
<td></td>
</tr>
<tr>
<td>11. Rate the following (true, false, not sure) hygienic measures.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. Rate the following (true, false, not sure) words</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13. How long can coronavirus live on hard surfaces?</td>
<td>2 out of 5 up to 72 hours</td>
<td>4 out of 5 up to 72 hours</td>
<td></td>
</tr>
<tr>
<td>14. Introducing a disinfectant into your body will protect you against COVID-19</td>
<td>1.20</td>
<td>1</td>
<td>18.18%</td>
</tr>
<tr>
<td>15. 5G mobile networks spread COVID-19</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>16. Exposing yourself to the sun or temperatures higher than 25 c degrees prevents COVID-19</td>
<td>1.80</td>
<td>1.20</td>
<td>40%</td>
</tr>
<tr>
<td>17. COVID-19 virus can be transmitted in areas with hot and humid climates</td>
<td>1.80</td>
<td>1.20</td>
<td>40%</td>
</tr>
<tr>
<td>18. COVID-19 is transmitted through houseflies</td>
<td>1.20</td>
<td>1.20</td>
<td>0</td>
</tr>
<tr>
<td>19. Pets can get infected by COVID-19</td>
<td>2.00</td>
<td>1</td>
<td>66.66%</td>
</tr>
<tr>
<td>20. Vaccines against pneumonia protect you against the new coronavirus</td>
<td>2.20</td>
<td>1.80</td>
<td>20%</td>
</tr>
<tr>
<td>21. If I hold my breathe for 10 seconds or more without coughing I am free from catching COVID-19</td>
<td>1.20</td>
<td>1.20</td>
<td>0</td>
</tr>
<tr>
<td>22. COVID-19 is more likely to affect...</td>
<td>1 out of 5 indicated everyone</td>
<td>3 out of 5 indicated everyone</td>
<td></td>
</tr>
<tr>
<td>23. I know the steps to put on and doff gloves</td>
<td>2.00</td>
<td>2.20</td>
<td>9.52%</td>
</tr>
<tr>
<td>24. How knowledgeable do you consider yourself about the steps to put and remove a mask</td>
<td>2.20</td>
<td>2.60</td>
<td>16.66%</td>
</tr>
</tbody>
</table>

Data in Table 2 shows the different answers about CoVid-19 before and after playing the game. Questions were classified in three different categories – a) the ones that had a 5 rating scale, b) true or false and c) selecting different options. Despite little to no indication of a vast knowledge gain in participants, some specific outcomes showed positive results. Questions 1 and 2 showed how there has been a slight change in attitude towards information about the virus.
virus. In the part of the MythBusters or symptoms, participants seemed to be aware about them, thus there were no significant changes, except in statement number 19.

In true or false type questions, there was an improvement of 10% with regards to knowledge gain, when it came to information about hygienic measures and the meaning of words such as “social distancing” and “asymptomatic”.

When it came to questions where participants had to select different options, there were slight changes. Questions 10 and 13 showed how some participants changed their mind after playing the game, indicating that the virus can last up to 72 hours on hard surfaces. When it came to symptoms, participants filled more options after playing the game. Questions 23 and 24 offered understanding on knowledge gain in the teaching of prevention measures such as putting on and removing mask and gloves. However, questions such as 3, 4 and 9 showed no changes. The results of the surveys were successful in bringing upon a small change relating to knowledge and awareness. The limited amount of participants suggests that discrepancies may exist in these results. This leads to a presumption that to have more successful qualitative data, the game should be tested with more participants, and a better scale and time for playing the game needs to be implemented, (Appendix 4).

6. EVALUATION/DISCUSSION

The designer believes that sending the survey to many countries like Belgium, Spain, India, Ecuador, and Sweden led to a variety of opinions that might have influenced the results of the survey, considering each country had been affected differently by the pandemic.

The designer wanted to approach the target audience with cultural probes to get an understanding if there could be significant knowledge gain after playing the game among this target group. The designer, however, also sent cultural probes to people at high-risk, not only to gain crucial perspectives of the problem from those that relied on extreme preventive measures but also because the target group's actions could indirectly harm the well-being of an at-risk group. These findings were applied to nurture empathy in the target group and were used to design one of the game's micro-games.

The designer believes adapting cultural probes into a digital version due to the COVID-19 might have influenced the outcome on different tasks. Each one of them had instructions contained in a folder, affecting the tasks' design to be open-ended and exploratory. In gamestorming, slight differences were observed as participants using digital probes were constrained by the PowerPoint file, and did not have the freedom to draw or write on a paper, like the ones that received physical probes.

Another concern was the workload on the participants, which lead to two out of six deciding not to complete all tasks because “it was too much.” Furthermore, some might argue that the mini-survey in the cultural probes did not differ too much from the generic survey. The designer believes that both surveys were essential to understanding convergent and divergent behavioural patterns.

Due to the exploratory nature of cultural probes, a focus group or a workshop session on Zoom would have been a better option for tasks such as gamestorming, which required participants to draw and use brainstorming techniques to come up with ideas and help develop a human-centered approach to the game.

Ideally, the designer would have preferred to test both playtesting sessions with the same people who filled the probes. However, restrictions due to the pandemic affected playtesting severely. The designer decided to conduct the first low-fi playtesting session with people who live in the same apartment complex, as it allowed for quicker and more convenient means to make necessary adjustments in the prototypes.

Thus, new participants were used for playtesting the low-fi versions; however, they claimed
the sessions were boring, since they could not drag, swipe, or get feedback in their interactions. This suggests that the designer could have tried to do digital sketching instead of simulating tapping or dragging with paper.

A major revelation was the game “Stay at Home,” inspired by the gamestorming tasks in the cultural probes. This indicated that cultural probes were vital in gathering a plethora of unique perspectives, which translated into game design that was enjoyable and accepted.

With respect to the hi-fi prototype, the designer believes that instead of prototyping the game with Sketch and using Principle to generate different animation of the screens, Scratch, another useful tool, would have helped push the game as open-source, leading it to being tested by its community of creators. Due to time constraints, though, the hi-fi prototype was designed using the former tools, which only allowed sharing it with Mac users, and in the physical playtesting, the designer had to play as the wizard of Oz (Hanington & Martin, Wizard of Oz, 2012).

Answering the main research questions, the evaluation method used for testing and knowledge gain proved to be successful but still needs to be developed further. The evaluation of the game revealed slight knowledge gains and increased awareness, but when the players were interviewed they claimed that the game had barely taught them anything new. The designer acknowledges that the limited amount of participants (five) in the playtesting might have hindered clear results. Moreover, in the hi-fi playtesting session, the only domain expert was a nurse that had been working with COVID-19 patients.

7. CONCLUSION

This paper describes the design process of developing a serious game through the use of human-centered design and game design methods to find an answer to the research question. During the elaboration of the project, several methods such as surveys, unstructured interviews, netnographies, and cultural probes were used to gain deeper knowledge about the problem domain and approach the target audience to understand if among young adults there is a sense of invulnerability towards the virus.

Scenario-based approaches were used to identify the different participants (extrinsically motivated, amotivated, and intrinsically motivated), to see how the playing experience of the game affected each one of them. The hi-fi prototype of the game was tested in one play-testing session with 5 different users, one of them being considered a domain expert. Three of them were physical sessions where the designer played as the Wizard of Oz, and two of them were sent to participants that were Mac users.

The designer conducted pre and post surveys as well as interviews, which showed that the game caused minor changes in knowledge gain and awareness about prevention measures to mitigate the spread of the virus. Participants stated that it was useful in gaining knowledge about hygienic measures; however, they stated that the game was too simple. They suggested they would play the game again only if more elements of personification and myth-buster (two of the most popular segments of the game) were added. Stay at Home may show significant potential in being further developed, especially if it were to be designed for a junior/younger age group. The game should also be tested with more participants, and a better scale and time for playing the game needs to be implemented for more comprehensive data. Moreover, the game is based on current guidelines and advice to the general public by institutions such as World Health Organization, CDC (Centers of Disease and Control), and the Swedish Health Agency, as of May 2020. However, information about COVID-19 spreads as fast as the virus itself, and everyday new research, news and medical information is added online. Any future versions of this game must consider these new findings.
7.1 Contribution to Interaction Design
As we have seen in this thesis, gamified application can have a positive effect on health by empowering a patient’s resilience and positive emotions. Serious Games are an emerging technology that can be used in a learning environment. The main contribution of Stay at Home is as a channel that can be embedded as a powerful learning tool to attract learners’ attention by offering knowledge in the teaching of hygienic and guidelines, through the use of game elements. The game could motivate users with the aim to educate and prevent tragedies that have occurred during the spread of COVID-19.

7.2 Future Work
The first steps of future work will fix the different bugs that the game presented in the playtesting sessions, such as in the “Body Scan” microgame. As suggested by participants, the game could take the perspective of including just a single item of personification, with more stories, scenarios, and several different microgames in it. Adjusting levels of difficulty would improve playing experience for users who found the game to be too simple. The game needs more concise text, since some participants did not read instructions due to the text length. The score or points should be placed on the main menu, instead of at the end of each microgame, since it can be confusing for players. As suggested by the participants, it could be an excellent tool for kids and adolescents in the teaching of following the guidelines to mitigate the spread of the virus. For future efforts, a more comprehensive evaluation with more participants would be beneficial, as this thesis only tested knowledge gain on a small scale. The evaluation method used for testing knowledge gain (pre and post surveys) proved to be successful, but still need to be developed further, specifically regarding knowledge on symptoms or MythBusters.

ACKNOWLEDGEMENTS
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APPENDIX 1
CONSENT FORM CULTURAL PROBES

Informed consent

<table>
<thead>
<tr>
<th>Project title:</th>
<th>Date:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Healthcare Gamification- serious game about COVID-19 (Stay at home)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Study manager:</th>
<th>Study manager:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maria López Hernández</td>
<td>Studying at Malmö University, Faculty of Culture and Society, S-205 06 Malmö</td>
</tr>
<tr>
<td>Your E-mail</td>
<td>Phone +46 40 665 70 00</td>
</tr>
<tr>
<td><a href="mailto:MI318464@gmail.com">MI318464@gmail.com</a></td>
<td>Education:</td>
</tr>
<tr>
<td></td>
<td>Level:</td>
</tr>
</tbody>
</table>

I have been verbally informed about the study and read the accompanying written information. I am aware that my participation is voluntary, and that I, at any time and without explanation, can withdraw my participation. The person/s leading the study will strive to guarantee confidentiality in that no unauthorized person may have access to the material. The gathered material will be stored properly and used for research purposes only.

I hereby submit my consent to:
- participate in
  - cultural probe (includes survey)
  - user testing

APPENDIX 2
UNSTRUCTURED INTERVIEWS QUESTIONS

How worried are you about COVID-19?
How is the situation at home?
Do you think that this is a severe threat?
How is the situation at the hospital? (nurse)
Do you think that people are aware of how severe the virus is? (nurse)
Can you tell me your routine during quarantine? (person with diabetes)
How often do you go out?
Have you seen any of your friends not taking the virus seriously?
Did you notice something different while walking the dog or going out for essentials?
How often do you watch the news?
Are you confused by the information overload?
Do you follow the guidelines and prevention measures?
Do you know the symptoms?
### APPENDIX 3

**MAIN SURVEY**

**Rolf E. 1. Background and methodology**

The present study is based on a national survey conducted in Sweden to investigate the impact of the COVID-19 pandemic on society. The survey was administered online to a representative sample of the Swedish population. The purpose of the study was to understand the psychological and behavioral responses to the pandemic. The survey included questions on various aspects such as public health measures, personal experiences, and attitudes towards the pandemic.

**2. Questions and Responses**

#### 2.1. Demographic Information

1. **Age group:**
   - Under 20
   - 20-30
   - 30-40
   - 40-50
   - Over 50

2. **Gender:**
   - Male
   - Female
   - Other

3. **Where do you live?**
   - Urban
   - Rural
   - Other

4. **Before the outbreak, how many hours would you spend out per day?**

5. **Do the following statements describe your behavior in the past weeks? (1 = not at all, 5 = all the time)**

<table>
<thead>
<tr>
<th>Statement</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>I stayed at home</td>
<td></td>
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<tr>
<td>I made more use of my time than usual</td>
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<tr>
<td>I met with friends or relatives more frequently than a week ago</td>
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<tr>
<td>I wore a face mask more than usual</td>
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<tr>
<td>I made more use of the internet than usual</td>
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<tr>
<td>I used my phone more than usual</td>
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<tr>
<td>I felt less stressed</td>
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<tr>
<td>I made more use of the phone</td>
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<tr>
<td>I used more video calls</td>
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<td>I felt less stressed</td>
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<td>I used more video calls</td>
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<td>I felt less stressed</td>
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<td>I made more use of the phone</td>
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<tr>
<td>I used more video calls</td>
<td></td>
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<td>I felt less stressed</td>
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<td>I made more use of the phone</td>
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<tr>
<td>I used more video calls</td>
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<td>I made more use of the phone</td>
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<td>I used more video calls</td>
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<tr>
<td>I made more use of the phone</td>
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<tr>
<td>I used more video calls</td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I felt less stressed</td>
<td></td>
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</tr>
</tbody>
</table>

6. **Have you left your home in the past two days?** Yes/No

7. **If yes, what are the reasons for you to leave your home?**

8. **Do you consider that non-essential shops should remain closed in your country even when the virus is under control?** Yes/No

9. **What is the main reason for leaving your home?**

10. **When going out for essentials, have you changed your journey to be as little bit more than usual?** Yes/No

11. **How much does the virus impact your daily life?** (1 = not at all, 5 = a lot)

<table>
<thead>
<tr>
<th>Impact</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slight</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moderate</td>
<td></td>
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</tr>
<tr>
<td>Severe</td>
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<td></td>
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<td></td>
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<tr>
<td>Extreme</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

12. **Does your country impose punishment if you do not follow the guidelines?**

Yes/No

13. **If yes, do you think the punishment is fair?**

Yes/No

14. **How many people in your country do you think believe that participation in social gatherings should be canceled (such as schools, kindergartens, workplaces, queues at offices, post, banks, etc)?**

15. **How much time per day do you watch the news about COVID-19?**

16. **How effective do you consider social distancing measures as slowing down the spread of the virus?**

17. **On a scale of 1 to 5 (1 = not at all, 5 = a lot):**

<table>
<thead>
<tr>
<th>Question</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>How worried are you about your health regarding COVID-19?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The health of my family members regarding COVID-19</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The health of my friends regarding COVID-19</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>The health of my colleagues regarding COVID-19</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Right now, how often do you go out?</td>
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</tr>
<tr>
<td>How often did you go out in the past week?</td>
<td></td>
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</tr>
<tr>
<td>How often do you go out in the past month?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>How often do you go out in the past year?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

18. **Do you think people should practice self-isolation and stay at home?**

Yes/No

19. **What are your plans for the weekend?**

20. **In case you have submitted this survey, do not forget to contact me:**

   email: [your_email@domain.com]

---

**End of Survey**

Thank you for taking the survey!
APPENDIX 3
MAIN SURVEY

19. If I feel the need to cough or sneeze, I cover my mouth and nose with
   - My hand
   - My sleeve
   - Facial tissue
   - elbow

20. When you see someone, you know we are in the streets of COVID-19 you...
   - wear your mask
   - keep a defined distance
   - maintain hand hygiene
   - wash hands
   - wear a mask
   - avoid direct contact

21. Symptoms of COVID-19 include...
   - Sore throat
   - Cough
   - Fever
   - My body
   - Unusual pain
   - Difficulty breathing
   - Faintness
   - Headache
   - Nausea
   - Shock
   - Vomiting
   - Loss of taste or smell
   - High fever

22. I keep a distance of 1 meter or more from others when coughing or sneezing
   - Agree
   - Disagree

23. How often do you wash your hands per day?
   - In all circumstances, at least 4 times

24. I wash my hands...
   - Before eating
   - After coming from outside
   - After using the toilet
   - After touching food or eating
   - After touching pets or their toys
   - After touching dirt or garbage
   - After touching public surfaces
   - After touching a person
   - Before leaving the house
   - Before touching a healthy family member of a friend
   - If other

25. Do you think that washing your hands is essential to protect you from the virus?
   - Yes, very
   - Yes, somewhat
   - No, it is not essential

26. What percentage of alcohol should your hand sanitizer have?
   - 45%
   - 80%
   - 95%
   - Other

27. Make the following true, false, or unsure:

<table>
<thead>
<tr>
<th>Statment</th>
<th>True</th>
<th>False</th>
<th>Unsure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wearing a mask and social distancing for the entire time?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drying your hands after touching a wet or soiled surface or object?</td>
<td></td>
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<tr>
<td>How much is the case and whether you have any history of respiratory illness?</td>
<td></td>
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<tr>
<td>How much you step from a déjà vu? What is the main reason for the sleep attack?</td>
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<tr>
<td>How much sleep do you get?</td>
<td></td>
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<tr>
<td>Sleeping in bed with someone can contribute to the spread of infection?</td>
<td></td>
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<tr>
<td>What is the consequence of not washing your hands?</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>PCOS does not increase the risk of illness?</td>
<td></td>
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<tr>
<td>How much do you eat when you have a cold or flu?</td>
<td></td>
<td></td>
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<tr>
<td>How much do you lose weight?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>What is the consequence of not washing your hands?</td>
<td></td>
<td></td>
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<tr>
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</tr>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PCOS does not increase the risk of illness?</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

28. How long can contagious live on hard surfaces?
   - Up to a month
   - Up to three months
   - Up to six months

29. How many people do you believe are most vulnerable to the virus?

<table>
<thead>
<tr>
<th>Group</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Acute</td>
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<td></td>
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</tr>
<tr>
<td>Pregnancy</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>People who are over 80</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Others</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>People who live in nursing homes</td>
<td></td>
<td></td>
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<tr>
<td>People with chronic lung conditions</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>People with serious heart conditions</td>
<td></td>
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<tr>
<td>People with diabetes</td>
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<tr>
<td>People with diabetes and conditions</td>
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<tr>
<td>People with diabetes and conditions</td>
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<tr>
<td>People with diabetes and conditions</td>
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</tr>
</tbody>
</table>

30. From the following list, which three people are most likely to be extremely affected by the virus

<table>
<thead>
<tr>
<th>Group</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
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<tr>
<td>Acute</td>
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<tr>
<td>Pregnancy</td>
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<td></td>
<td></td>
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<tr>
<td>People who are over 80</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Others</td>
<td></td>
<td></td>
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<tr>
<td>People who live in nursing homes</td>
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<tr>
<td>People with chronic lung conditions</td>
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<tr>
<td>People with serious heart conditions</td>
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<tr>
<td>People with diabetes</td>
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<tr>
<td>People with diabetes and conditions</td>
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<td>People with diabetes and conditions</td>
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</tr>
<tr>
<td>People with diabetes and conditions</td>
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<td></td>
</tr>
</tbody>
</table>
APPENDIX 4
PRE-TEST SURVEY

1. How knowledgeable do you consider yourself about COVID-19?
   
<table>
<thead>
<tr>
<th>Not Knowledgeable</th>
<th>Knowledgeable</th>
<th>Very Knowledgeable</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2. I consider myself to be confused about prevention measures and guidelines

<table>
<thead>
<tr>
<th>Strongly disagree</th>
<th>Neutral</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3. How important do you consider it is to check for information in reliable sources such as WHO, CDC, and government and medical institutions

<table>
<thead>
<tr>
<th>Not important</th>
<th>Neutral</th>
<th>Very important</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td></td>
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</tbody>
</table>

4. You consider hygienic measures to be...

<table>
<thead>
<tr>
<th>Not important at all</th>
<th>Neutral</th>
<th>Very important</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

5. Washing your hands is essential to protect you from the virus?

<table>
<thead>
<tr>
<th>Not important at all</th>
<th>Neutral</th>
<th>Very important</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

6. What percentage of alcohol should your hand sanitizer have?

   |                        |          |               |
   |                        |          |               |

7. I wash my hands...

   |                        |          |               |
   |                        |          |               |

8. Symptoms of COVID-19 include...

<table>
<thead>
<tr>
<th>Difficulty breathing</th>
<th>Fever</th>
<th>Sneezing</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

9. I keep a distance of 1.5 meters or more from others when coughing or sneezing

<table>
<thead>
<tr>
<th>Strongly disagree</th>
<th>Neutral</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

10. If I feel the need to cough or sneeze, I cover my mouth and nose with ...

11. Rate the following (true, false, not sure):

<table>
<thead>
<tr>
<th>Wearing a mask can avoid getting the virus if I am infected</th>
<th>True</th>
<th>False</th>
<th>Not sure</th>
</tr>
</thead>
<tbody>
<tr>
<td>I can touch my eyes without problems when shopping in the supermarket</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I can touch my nose and mouth without problems when shopping in the supermarket</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>While grocery shopping I should make sure to wash my hands before entering the store or during breaks</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Touching my face outside my home can help the virus get into my body</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>After grocery shopping I should wash my hands in an immobile container (plastic bag, bowl, or apron)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>You should wash your hands after handling food packaging and before you prepare food for eating and before you eat</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wearing gloves doesn’t change anything if the item you’re handling is contaminated</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>COVID-19 is not infected via contaminated hands</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wearing a mask is not recommended because it will not provide good protection</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Handshakes as masks are totally effective</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

12. Rate the following (true, false, not sure):

   | Social distancing means keeping away from people who live outside your home | True | False | Not sure |
   | Community transmission/spread means that affected people can spread the disease to others |       |       |         |
   | If someone has no symptoms and can go out then isolation and quarantine mean the same |       |       |         |
   | Asymptomatic and incubation period mean the same |       |       |         |
   | If someone has no symptoms and can go out then isolation and quarantine mean the same |       |       |         |

13. How long can coronavirus live on hard surfaces?

14. Introducing a disinfectant into your body will protect you against Covid-19

<table>
<thead>
<tr>
<th>Strongly disagree</th>
<th>Agree</th>
<th>COVID-19 fully agree</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

15. 5G mobile networks spread COVID-19

<table>
<thead>
<tr>
<th>Strongly disagree</th>
<th>Neutral</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX 4
PRE-TEST SURVEY SUNET - PAPER VIEW

16. Exposing yourself to the sun or temperatures higher than 23°C degrees prevents COVID-19

17. COVID-19 virus can be transmitted in areas with hot and humid climates

18. COVID-19 is transmitted through households

19. Pets can get infected by COVID-19

20. Vaccines against pneumonia protect you against the new coronavirus

21. If I hold my breathe for 10 seconds or more without coughing I am free from catching COVID-19

22. COVID-19 is more likely to affect...

23. I know the steps to put and doff gloves

24. How knowledgeable do you consider yourself about the steps to put and remove a mask

APPENDIX 4
POST-TEST SURVEY

1. Having played the game, how knowledgeable do you consider yourself about COVID-19?

2. I consider myself to be confused about prevention measures and guidelines

3. How important do you consider it is to check for information in reliable sources such as WHO, CDC, and government and medical institutions

4. After playing the game you consider hygienic measures to be...

5. After playing the game I consider washing hands to be...

6. What percentage of alcohol should your hand sanitizer have?

7. I wash my hands...

8. Symptoms of COVID-19 include...

9. If you see a member of your family, neighbor or friend while going out you...

10. I keep a distance of 2 meter or more from others when coughing or sneezing

11. If I feel the need to cough or sneeze, I cover my mouth and nose with...
### APPENDIX 4
### POST-TEST SURVEY

13. Rate the following (true, false, not sure):

<table>
<thead>
<tr>
<th></th>
<th>True</th>
<th>False</th>
<th>Not sure</th>
</tr>
</thead>
<tbody>
<tr>
<td>I can use a loose mask.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I can touch the level of the mask.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I can totally remove the mask to talk to someone.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I can reuse the mask.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I can put on a mask only over mouth or nose.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Using gloves all day will prevent me from catching COVID-19.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I can totally touch my face with the gloves on.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

14. Rate the following (true, false, not sure):

<table>
<thead>
<tr>
<th></th>
<th>True</th>
<th>False</th>
<th>Not sure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Social distancing means staying away from people who live outside your home</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quarantine means staying home for 14 days if you've recently been exposed to COVID-19.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Isolation means separating yourself from other people because you're sick.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Isolation refers to the voluntary confinement of people who are sick, or those who need to quarantine to see if they become sick.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Social distancing and self-isolation means exactly the same.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asymptomatic means someone who has no symptoms and can go to work.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asymptomatic and isolation period mean the same.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Community transmission/spread means that infected people a disease does not have to have a history of travel or close contact to known case.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

15. How long can coronavirus live on hard surfaces?

16. Introducing a disinfectant into your body will protect you against COVID-19?

<table>
<thead>
<tr>
<th></th>
<th>Strongly disagree</th>
<th>Agree</th>
<th>Strongly agree</th>
</tr>
</thead>
</table>

17. 5G mobile networks spread COVID-19

<table>
<thead>
<tr>
<th></th>
<th>Strongly disagree</th>
<th>Neutral</th>
<th>Strongly Agree</th>
</tr>
</thead>
</table>

18. Exposing yourself to the sun or temperatures higher than 25°C prevents COVID-19

<table>
<thead>
<tr>
<th></th>
<th>Strongly disagree</th>
<th>Neutral</th>
<th>Strongly Agree</th>
</tr>
</thead>
</table>

19. COVID-19 virus can be transmitted in areas with hot and humid climates

<table>
<thead>
<tr>
<th></th>
<th>Strongly disagree</th>
<th>Neutral</th>
<th>Strongly Agree</th>
</tr>
</thead>
</table>

20. I keep a distance of 2 meters or more from others when coughing or sneezing

<table>
<thead>
<tr>
<th></th>
<th>Strongly disagree</th>
<th>Neutral</th>
<th>Strongly Agree</th>
</tr>
</thead>
</table>

21. COVID-19 is transmitted through houseflies

<table>
<thead>
<tr>
<th></th>
<th>Strongly disagree</th>
<th>Neutral</th>
<th>Strongly Agree</th>
</tr>
</thead>
</table>

22. If I hold my breath for 10 seconds or more without coughing I am free from catching COVID-19

<table>
<thead>
<tr>
<th></th>
<th>Strongly disagree</th>
<th>Neutral</th>
<th>Strongly Agree</th>
</tr>
</thead>
</table>

23. COVID-19 virus can be transmitted in areas with hot and humid climates

<table>
<thead>
<tr>
<th></th>
<th>Strongly disagree</th>
<th>Neutral</th>
<th>Strongly Agree</th>
</tr>
</thead>
</table>

24. Pets can transmit COVID-19

<table>
<thead>
<tr>
<th></th>
<th>Strongly disagree</th>
<th>Neutral</th>
<th>Strongly Agree</th>
</tr>
</thead>
</table>

25. COVID-19 is more likely to affect...

<table>
<thead>
<tr>
<th></th>
<th>Strongly disagree</th>
<th>Neutral</th>
<th>Strongly Agree</th>
</tr>
</thead>
</table>

26. Having played the game, you consider following the guidelines to be essential for mitigating the spread of the virus

<table>
<thead>
<tr>
<th></th>
<th>Strongly disagree</th>
<th>Agree</th>
<th>Strongly agree</th>
</tr>
</thead>
</table>

27. Having played the game and haven put yourself in the skin of someone at high risk do you consider yourself to be

<table>
<thead>
<tr>
<th></th>
<th>Least sympathetic</th>
<th>Sympathetic</th>
<th>Very sympathetic</th>
</tr>
</thead>
</table>

28. Having played the game how knowledgeable do you consider yourself to be about putting and removing gloves

<table>
<thead>
<tr>
<th></th>
<th>Not knowledgeable</th>
<th>Knowledgeable</th>
<th>Very knowledgeable</th>
</tr>
</thead>
</table>

29. Having played the game how knowledgeable do you consider yourself to be about putting and removing a mask

<table>
<thead>
<tr>
<th></th>
<th>Not knowledgeable</th>
<th>Knowledgeable</th>
<th>Very knowledgeable</th>
</tr>
</thead>
</table>