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PrivaCity: A Chatbot Serious Game to Raise the Privacy Awareness of Teenagers

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Summary

In the modern society collection of data happens everywhere, and consequently, privacy is an ever-growing concern. It has been shown that people, and especially teenagers, lack awareness around the data they share and the associated privacy risks. Furthermore, no one has taken on the responsibility of training teenagers to become responsible digital users with a good understanding of the privacy risks they expose themselves to.

A lot of focus is dedicated to raising awareness around what to share and not to share on social networks, but little is done to learn about the risks of the digital footprints left by simply using digital services. Services may seem free of charge; however, they are not paid for with money - but with personal information. In smart cities, data is collected about the citizens across a multitude of small digital sensors, which raise privacy concerns on how the information can and should be used.

This thesis explores how chatbot serious games can be used as a tool to raise privacy awareness. The focus is on which game elements work well in a chatbot serious game - both to engage the player, and to raise his awareness. To answer this we have conducted a literature review on existing chatbot serious games, designed and developed PrivaCity as a chatbot prototype for a serious game to raise privacy awareness on digital risks in smart cities. The game and its elements have been evaluated with 104 Norwegian teenagers as participants. Finally, based on the experiences made in the previous steps, a set of guidelines for chatbot serious games is presented. The guidelines can be used by anyone wishing to design or develop a chatbot serious game.

Through the evaluation of the game PrivaCity, it is found that the game elements that work best for learning and raising awareness in a chatbot serious game are quizzes, real-life examples and seeing the consequences of one's actions. The game elements that work best to engage the player are curiosity and being able to explore freely, and to shape the narrative and story of the game with actions. The game PrivaCity mainly focuses on the privacy concerns of a smart city. But by utilizing the knowledge and guidelines presented in this report, one can also design a successful chatbot serious game for other scenarios or problem domains.

Problem Description

Increasing awareness about privacy and personal data with games

Advancements in information technology have made people less aware of the collection and usage of personal data. As a result, individuals rarely have a clear knowledge of what information other people and firms store about them or how that information is used. The problem is made even more pressing with the increasing adoption of IoT and interactive objects, promoting new forms of interaction and data collection for which new strategies need to be developed.

This task aims to investigate how to use serious games and scenario tools to evoke reflection about sharing of personal data and privacy and promote learning about these issues. Games in this context are intended as a way to help players to see things differently and reflect on their actions, their consequences, and trade-offs of one's choices.

The task might be specialized to consider (i) challenges to personal data set by different types of technology (e.g. mobile, IoT, social media, ...), (ii) different types of games (e.g. mobile games, board games, ...), (iii) different type of users (e.g. children, the elderly, ...).

The task will start with the identification of some relevant scenarios and a study of current literature. It will then continue with the iterative development of a prototype to be evaluated with users.

Preface

This thesis is submitted to the Norwegian University of Science and Technology as the final fulfilment of the requirements for a master's degree in computer science. The work has been conducted at the Department of Computer Science.

We would like to thank our supervisor Monica Divitini for her invaluable feedback and motivation. Your guidance has given us an insight into the world of research and empirical studies, and helped us structure our work and to stay on track. We are glad for all the opportunities you have given us with your expertise and network.

We would also like to thank:

- Our fellow computer science students who volunteered to help us pilot test the game PrivaCity.
- The 4 teachers at middle and high school level which has taken valuable time out of their schedule to evaluate our game with their classes.
- All the 104 students who participated in the evaluation of PrivaCity, giving us honest feedback and evaluating the game.

Trondheim, June, 2018

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[1] *Hi Poncho* (2018). `https://www.messenger.com/t/hiponcho`. (Visited on Feb. 21, 2018).

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Abbreviations

SG Serious Game

GDPR General Data Protection Regulation

SNS Social Network Site

PGCW Privacy Game Co-Design Workshop

NLP Natural Language Processing

NPC Non-Playable Characters

AIML Artificial Intelligence Markup Language

SDK Software Development Kit

IoT Internet of Things

Chapter 1

Introduction

1.1 Motivation

Privacy is an ever growing concern in today's world of digital applications and services. With the technological development and increase in the use of connected devices, data is being collected everywhere, and people are expected to know the risks they expose themselves to by using such services. Terms of service are complicated and often just a click-to-agree that very few looks at and close to no one reads[1], leaving people unaware of what type of data they share, with whom and what it is used for.

Today companies are to a greater extent providing access to their digital services free of charge, as people no longer pay with money, but with personal data. This seemingly free purchase of a service often includes the surrender of personal data, which Gates and Matthews (2014) suggest to be the "new currency" of the digital economy. The General Data Protection Regulation (GDPR) in Europe having taken effect in May 2018 addresses some of these concerns requiring simpler language when asking for consent and a more transparent model of how collected data will be processed and used, showing the great interest in privacy.

A study conducted by NorSIS (2017) shows that among Norwegian youth only 28,4% say they have received training in information security in the last two years as opposed to 52,4% of adults. Despite this, there are few initiatives to educate youth, and at the moment nobody is responsible for children and teenagers becoming responsible internet users with good knowledge regarding privacy concerns. Therefore this report explores how young people can learn about sharing of personal data and privacy in an engaging and evoking manner; through serious games. Serious games (SG) can be defined as games that are made with a primary design objective that is not entertainment, unlike most games

[1] *Click to agree with what?* (2017). `https://www.theguardian.com/technology/2017/mar/03/terms-of-service-online-contracts-fine-print`. (Visited on Nov. 27, 2017); *Norway Watchdog Wants Fewer Words in App Terms* (2017). `https://www.wsj.com/articles/norways-consumer-council-reads-app-terms-in-live-stream-1464193961`. (Visited on Dec. 11, 2017).

(Laamarti, Eid, and El Saddik 2014). Instead, the main objective is to educate, motivate or promote behavioral change. Although serious games is no new concept (Apt 1970), interest in the field of serious games are on the rise as they are often considered more entertaining, and time and cost efficient than traditional learning methods such as lectures and traveling to conventions (Ma, Oliveira, and Pereira 2012; Malheiros et al. 2011).

The specific type of serious game researched in this report is chatbots. Technological advances have made the development of highly functional chatbots easier than ever before. Chatbots are able to offer a simplicity and personalization factor that outperforms many mobile, web and other applications. Additionally, studies (Kiili 2005; Ravyse et al. 2017) have shown that players do not require audio-visually rich games to be effective learning tools. We therefore believe a chatbot serious game can be an effective and fun way to raise the privacy awareness of teenagers. The main problem domain chosen for the chatbot serious game prototype in the report, PrivaCity, is the privacy issues in smart cities. It is a topic which has received little attention, yet is highly relevant in today's society.

Adventure games are one of the most common types of serious games, alongside quizzes and simulations (Granic, Lobel, and Engels 2014; Connolly et al. 2012), yet the genre has received little attention in chatbot serious games. Adventure games are games with an interactive story driven by exploration and puzzle-solving, which may suit the interactive nature of a chatbot serious game. In this thesis we will explore if this is the case, and how to use adventure-based chatbot serious games to raise the privacy awareness of teenagers, identifying which game elements can be used to engage the player and raise his awareness.

1.2 Context

This work is a master thesis for the Department of Computer Science at the Norwegian University of Science and Technology (NTNU). The research in this master is a continuation of a specialization project (Berger and Sæthre 2017) focusing on specific privacy scenarios in serious games to raise privacy awareness.

The main results from the specialization project identified that there is a lack of diversity in the scenario of the existing serious games for privacy awareness. Existing serious games focus solely on one scenario; what you share with your friends on social networks. In order to identify what scenarios are relevant to teenagers, a set of possible scenarios was proposed, and a co-design game design workshop (PCGW) was designed to be conducted with teenagers as participants. The workshop was finally run with 32 Norwegian high school students. The results of the user study were not a part of the specialization project, and are presented in a paper in Appendix A. The paper has been submitted for International Conference on Entertainment Computing (IFIP-ICEC'18)[2].

The work is conducted in cooperation with Norwegian Computing Center[3], NR, as a part of the Awareness Learning Tools for Data Sharing Everywhere (ALerT) project. The ALerT project is a project which will develop tools for evoking awareness about personal information in digital environments.

[2] *International Conference on Entertainment Computing (IFIP-ICEC'18) - POZNAN, POLAND, SEPTEMBER, 17-20TH, 2018* (2018). `http://www.ifip-icec.org/`. (Visited on May 30, 2018).

[3] *Norsk Regnesentral* (2017). `https://www.nr.no/`. (Visited on Nov. 27, 2017).

The main supervisor for the project is Professor Monica Divitini, which has guided the authors thoroughly in all parts and aspects of the project. Additionally, the authors received guidance from Monica's research team: Anna Mavroudi as an expert on learning analytics, and Simone Mora and Francesco Gianni as experts on workshops.

1.3 Research Questions

Serious games have been used in many settings, for instance to train workers in crisis situations (Loreto, Mora, and Divitini 2012), as well as to increase awareness around societal issues (Rebolledo-Mendez et al. 2009). The specialization project (Berger and Sæthre 2017) uncovered successful privacy serious games, and by combining the novelty of a chatbot game with the known success of privacy serious games, we believe it can create a new, entertaining way of raising privacy awareness.

> **RQ1**: How can chatbots be used in adventure-based serious games to raise awareness of data privacy risks?

The co-design workshop showed that recurring game ideas were adventure based games with a rich story and raised awareness by having consequences of actions. A chatbot game could realize many of these ideas without enormous development costs, and solve many of the problems presented in the specialization project (Berger and Sæthre 2017). Therefore it is this idea; how one can use chatbot serious games in a privacy context, which is the foundation for the main research question in this research.

> **RQ1.1**: How can the game genre "adventure" be used in chatbot serious games for privacy awareness?

Adventure games (or narrative games) are games where the player assumes the role of a protagonist in an interactive story driven by exploration and puzzle-solving (Rollings and E. Adams 2003). The adventure genre is one of the most common types of serious games and has been studied to a great extent (Connolly et al. 2012). However, the adventure genre in chatbot serious games has received little attention. Therefore this report will explore how the adventure genre can be used in chatbot serious games.

> **RQ1.2**: How can chatbot serious games engage the user?

In a serious game it is important to engage the player in the game. For the game to be successful in its "serious" aspect, studies show that first the player needs to have fun (Ravyse et al. 2017). Thus, one of the main success factors for a serious game is to not impede this hunger for fun, but rather stealthily use it to engage the player in the learning material. This thesis will explore what elements can be used to engage the player in a chatbot serious game.

> **RQ1.3**: How can chatbot serious games raise awareness?

Once the player is engaged in the game, one has to look at how to achieve the "serious" aspect of a serious game. Just like there are many ways to engage the player in the game, there are many ways to raise the awareness of the player. Which elements work well in a chatbot serious game, and which don't? This sparked the research question RQ1.3.

1.4 Research Method

To initiate the work in this thesis, the co-design workshop designed the specialization project (Berger and Sæthre 2017) was run with 32 Norwegian high school students. The games created during the co-design workshops were analyzed (see Appendix A), and the results formed the research questions in this thesis.

To answer the research questions and provide a conceptual framework for the thesis, a literature review is conducted. From the literature review, a set of possible game elements to engage and learn in a chatbot serious game is identified. As a result of the literature review, problems identified in the specialization project, and outcome from the earlier mentioned co-design workshop, a game design is proposed and a game prototype developed. The game design is an iterative process, with several groups of participants testing and evaluating the game. First university students in a pilot test, and later teenagers in the main evaluation - the target group of the game. Data is collected with observations, questionnaire, game data, and group interviews discussing strengths and weaknesses of the game and game design. Figure 1.1 shows the research process, with the steps outlined in red.

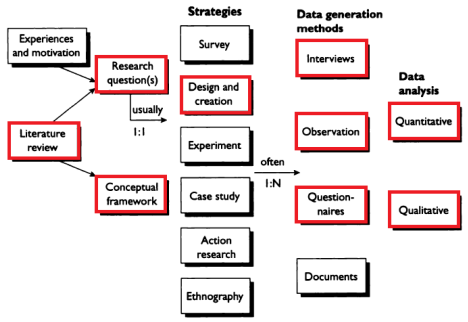

Figure 1.1: Research Process (Oates 2005)

As explained, this research is a continuation of the specialization project and builds upon the findings made in the report (Berger and Sæthre 2017). The proposed game design is a direct response to the identified lack of scenario diversity in existing serious games for privacy awareness.

Future work includes implementing the suggested changes after the main evaluation, and to use the knowledge from this thesis to create new serious games to raise privacy awareness for other topics or scenarios.

1.5 Results

This thesis presents several contributions to the field of chatbot serious games for privacy awareness: a *literature review*, a *game design* and *prototype* of the serious game PrivaCity. The prototype is evaluated in the main evaluation, and *engagement and learning game elements* that work well in an adventure chatbot serious game are identified. As a result

of the findings, a set of *guidelines for chatbot serious games* is presented, which can be utilized by anyone who wishes to develop a chatbot serious game. See Figure 1.2 for a graphical visualization of the contributions.

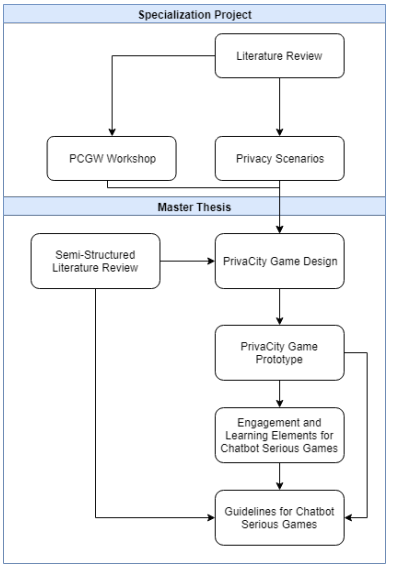

Figure 1.2: Contributions presented in this report. The work is a continuation of a specialization project. From the workshop results, privacy scenarios and literature review a game design of PrivaCity are presented and implemented. The prototype is evaluated, and as a result engagement and learning elements, as well as general guidelines for chatbot serious games, are presented.

The literature review presents how chatbots and the game type adventure have been researched previously, and how this work is positioned in the research area. The literature review identifies the trends in both learning and engagement game elements in existing games, in addition to exploring which technologies have been used. The literature review also explores ”Consequential play”; how consequences of actions are used to raise awareness of the player - a recurring theme in the user study co-design workshop results (see Appendix A).

Based on the findings in the literature review, privacy scenarios and co-design workshop results, a game design for PrivaCity is presented. PrivaCity is a chatbot serious game designed to raise the awareness of privacy risks in smart cities. The target group is teenagers. The serious game is divided into levels, where each level has clearly defined learning goals, learning elements, and engagement elements.

One of the main contributions of the thesis is the game PrivaCity itself. In order to test the ideas in the game design, a chatbot prototype based on the game design was developed. The game is available online at `http://privacity.herokuapp.com/` and on Facebook Messenger upon request. A short video demonstrating the main concepts of PrivaCity can be found at `https://youtu.be/fio3eYKd8_8`.

The game is evaluated in the main evaluation with 104 Norwegian teenagers as participants. Based on the evaluation, the engagement and learning elements that work best

in adventure-based chatbot serious games is presented. This helps to answer the research questions about how to engage and raise the awareness of the player.

The final contribution of the thesis is the set of guidelines for privacy awareness chatbot serious games which will help answer the RQs. The guidelines are combined based on previous findings made in the literature review, design and development of PrivaCity, and evaluations of the game. The guidelines can be used by anyone wishing to develop a chatbot serious game. Also for other scenarios than the one chosen in PrivaCity; digital privacy concerns in a smart city. We believe they can and should be employed to any chatbot serious game which aims to raise the awareness of the player on a certain topic, like privacy awareness.

1.6 Outline of the Thesis

Chapter 2 elaborates the problem definition, related contexts in detail and presents findings from the specialization project (Berger and Sæthre 2017). In *Chapter 3*, a literature review on chatbot and adventure serious games is presented and discussed. *Chapter* 4 introduces the game of PrivaCity. The storyline of the game is presented, with an in-depth description of each level, including learning goals and elements used to educate and entertain. The technical aspects of the game are presented in *Chapter 5*, discussing technologies, frameworks, and difficulties encountered. *Chapter 6* presents the first pilot test of PrivaCity with the resulting changes. In *Chapter 7* the main evaluation of the game with 104 participants is presented. *Chapter 8* presents a set of guidelines that can be used by other researchers in the creation of similar chatbot serious games. Finally, in *Chapter 9* we present the conclusions of the study.

A discussion is presented within the relevant chapters, and a dedicated chapter for discussion is therefore not necessary.

Appendices include: The paper ”Supporting co-design of games for privacy awareness” (Appendix A), the PrivaCity post-game questionnaire (Appendix B), changelog with minor changes made to PrivaCity (Appendix C), PrivaCity Game Details (Appendix D), and Consent form for research project (Appendix E).

Chapter 2

Problem Elaboration

The teenagers of today are digital citizens. They have grown up using digital aids in a way that no generation before them has ever done, having no limit between the physical and the digital world (NorSIS 2017). With the emerging trend of connected devices and IoT, data is shared in ways never seen before, leaving people unaware of the risks they are exposing themselves to. Therefore it is crucial that their awareness around privacy concerns and sharing of personal data is highly acute.

Norway is one of the world's most digital societies[1], and Norwegian teenagers associate a lower perception of risk in online activities than the general population, as well as thinking they are able to decide what is safe and not better than most people (NorSIS 2017). In other words - young people overestimate their ability to determine safe internet behavior.

Sharing of information happens in through a wide range of services. The users share information with friends on i.e. a social network, but also with the provider of said service, thus the company. In both cases the data shared can be abused, and in both cases the user has to trust that the receiver of the information doesn't have any hidden agendas with the data. A big difference between the two problems is whether the user is aware of the information actually being shared. When sharing information with friends, one usually presses a "share" button. In the case of sharing information with companies, the sharing is much more invisible. Once the user has given a service permission to collect their data, it is collected by simply using the service. The provider of this service can even develop sustainable business models based on commercializing and selling people's data. (Elvy 2017)

People in general aren't aware of the collection and usage of personal data. Individuals rarely have a clear knowledge of what information organizations and other people store about them or how that information is used. Adults may receive training in the workplace by experts, whereas 25% of Norwegian teenagers aren't even aware if they have received any training in information security practices (NorSIS 2017). Nobody holds the respon-

[1] *The Global Information Technology Report 2016* (2016). URL: https://www.weforum.org/reports/the-global-information-technology-report-2016/ (visited on Feb. 12, 2018).

sibility of making children and teenagers becoming responsible digital citizens with good knowledge regarding privacy concerns.

There is a recognized need for teaching teenagers about privacy, and an example of a learning-initiative for raising privacy awareness is Dubestemmer.no[2]. It is a Norwegian government-funded internet resource for children and teenagers to learn and raise awareness and discussion about privacy and safe digital behavior. The site consists of informational videos, texts and discussion questions to be used in classroom settings or individually by children or teenagers. However, using informational text and animated videos is a traditional and formal educational perspective. This thesis will explore how teenagers can learn about sharing of personal data and privacy in a more engaging and evoking manner; through serious games.

In March 2018, internet privacy became a hot topic. In what is known as the *Facebook-Cambridge Analytica Data Scandal*, the company Cambridge Analytica got access to the Facebook data of 87 million users[3]. The data was analyzed and used to create psychological profiles of the users, which exposed their prejudices, fears, and hopes. The profiles determined which users were possible to influence, and were then sold to political campaigns such as the Trump and Brexit campaigns. The political campaigns could then target users with personal advertisements, messages, and targeted news stories and create a seemingly ”personal” connection with the voters[4]. Up until now, this type of personal data has mainly been used for things like targeted advertisements. However, this exposes a new threat to the privacy of digital citizens and poses an ethical dilemma. For what purposes is it OK to use personal data, and what information is considered private? This is the concept of privacy.

2.1 The Concept of Privacy

There exists a wide array of privacy conceptualizations literature. This section will consider different theories before defining an approach to be used throughout this thesis.

2.1.1 Privacy as Control

A common conception of privacy is *privacy as control* introduced by Westin (1968), and articulated in different ways since (Crabtree, Tolmie, and Knight 2017). Charles Fried defines privacy as control over knowledge about oneself and further elaborates that it is not only control of the quantity of data, but also in the quality of information, as we might not mind that a person knows a general fact about us, and yet feel our privacy invaded if he knows the details (Fried 1968). Privacy as control can be summarized as the right, claim and ability to limit, filter, and control the flow and use of personal data (Crabtree, Tolmie, and Knight 2017).

[2] *Dubestemmer.no* (2018). `http://www.dubestemmer.no/`. (Visited on Feb. 12, 2018).

[3] *Facebook scandal 'hit 87 million users'* (2018). `http://www.bbc.com/news/technology-43649018?ns_mchannel=social&ns_campaign=bbc_breaking&ns_source=twitter&ns_linkname=news_central`. (Visited on Apr. 19, 2018).

[4] *The Science Behind Cambridge Analytica: Does Psychological Profiling Work?* (2018). `https://www.gsb.stanford.edu/insights/science-behind-cambridge-analytica-does-psychological-profiling-work`. (Visited on Apr. 19, 2018).

2.1.2 Privacy as Boundary Management

Originating from the works of Altman (1975), *privacy as boundary management* refers to the selective access of one's self to others. Altman argues that there is at any time an "optimal degree of desired access of the self to the others". From this, we can say that privacy as a boundary management is the continuous process of boundary management governed by rules of data access and disclosure (Crabtree, Tolmie, and Knight 2017).

2.1.3 Contextual Integrity

Especially relevant for serious games is the concept of *contextual integrity* presented by Helen Nissenbaum in (Nissenbaum 2004; Nissenbaum 2009), which is frequently used to understand privacy concerns and issues related to voluntary sharing of information, such as on social networking sites (SNS). Privacy considered by contextual integrity is about respecting the social norms of the situation. These norms can be created by conventions, culture or history. Sharing information by and of itself is not a privacy issue by this definition. The issue only arises when the information is shared outside the context of the situation. In the case of SNSs, sharing an embarrassing photo with close friends may not be a privacy issue, however when said photo leaves the intended context and becomes available to parents or future employers the privacy is violated. A less obvious example of the contextual integrity of privacy is when a user provides a service with his personal information, i.e sharing geolocation information. If the service provider uses the information as intended - to provide an improved service the privacy is not violated. However if the information is sold to advertising networks or otherwise out of context, the contextual integrity of the privacy of the user is violated.

2.1.4 Privacy Calculus & Trade-Offs

Another interesting conceptualization of privacy is the *privacy calculus* as pointed out by Laufer and Wolfe (1977). In the privacy calculus, the user weighs the risks and benefits of a decision, for instance whether or not to share a photo or current geo-location. Therefore the decision to share information or not is merely a matter of weighing the trade-offs; at what cost are we willing to give up our private data? In order to receive desired services, people tend to give up private information such as location data, health data, and consumption-rate data. The Economist stated in 2017 that "the world's most valuable resource is no longer oil, but data,"[5] and today world-leading companies such as Google and Facebook build their business models around collecting, analyzing and mining such user data, leaving them with immense power. Personal Data Economy (Elvy 2017) is an emerging business model where companies like Datacoup[6] purchase private data directly from the user and sell it on to third parties. The term incentivized location-sharing gets introduced in the user study (Hutton, Henderson, and Kapadia 2014) where people are given a direct monetary incentive to share their location with a business or service. The

[5] *Regulating the Internet Giants: The World's Most Valuable Resource Is No Longer Oil, but Data* (2017). `http://www.economist.com/news/leaders/21721656-data-economy-demands-new-approach-antitrust-rules-worlds-most-valuable-resource`. (Visited on Feb. 13, 2018).

[6] *Datacoup* (2018). `https://datacoup.com/`. (Visited on Feb. 13, 2018).

results show that while monetization does not necessarily alter the frequency of location sharing, people's motivations for sharing are changed. Additionally, the results show that people's concern and awareness regarding privacy were increased, proving that application designers can be transparent about the use of user data without discouraging adoption of the service, and simultaneously gain user trust.

In this thesis, the concept of privacy will be based off a combination of the Contextual Integrity and Privacy Calculus. The decisions of a user, or player in a SG, can be seen as a result of the privacy calculus, whereas whether the privacy of the user has been violated or not can be viewed in the light of the concept of Contextual Integrity. Privacy as Control, being the most common understanding of privacy (Crabtree, Tolmie, and Knight 2017), as well as Privacy as Boundary Management could also have been used. But in order to get a richer and better understanding of privacy, this thesis values the context of a privacy scenario, which might help the design of a better serious game (Birnhack 2011).

2.2 Behavioural Change & the Privacy Paradox

To achieve a behavioral change in the privacy practices of users is difficult both with and without serious games. It is shown that raising the privacy awareness often is achieved, but that the subject doesn't necessarily change his behavior (Blythe and Coventry 2012). Furthermore, it is very difficult to teach one way "to do things right", as the privacy preferences will differ from individual to individual and choices depend heavily on the context of the situation.

Another problem that has been researched is that people's views of online privacy are full of contradictions. An example is that people frequently say they have a higher level of privacy concern than what their behavior indicates (Norberg, D. R. Horne, and D. A. Horne 2007; Phelan, Lampe, and Resnick 2016). This mismatch is known as the "privacy paradox".

Because of these difficulties, it is more important to try to raise the awareness of teenagers, than attempting to change their behavior right away. By being aware of the consequences of privacy-related actions one will affect the privacy calculus, making it easier for the subject to clearly see the trade-offs of their actions.

2.3 The Lack of Diversity in Existing Serious Games

In a specialization project (Berger and Sæthre 2017) prior to this thesis, we conducted a systematic literature review in order to get a thorough understanding of the topic and how it has been researched previously. The systematic search was focused on existing serious games to raise privacy awareness and user studies using serious games to raise privacy awareness.

Scenarios

There are many domains, problems and aspects of privacy which can be considered when creating a serious game for privacy awareness. These can be viewed as "scenarios" that

the game focuses on.

The results show that all existing serious games in the literature review (Cetto et al. 2014; Vanderhoven et al. 2015) for privacy awareness focus on the scenario of what to share on SNS. However, there are a lot of other scenarios related to privacy concerns that could be focused on in games, as will be presented in section 2.4. Therefore there exists a lack of diversity in the existing serious games.

Technologies

All existing serious games for privacy awareness are designed for the traditional technology computer platform - to be played with a mouse and keyboard. This shows a lack of variety in the technologies in which the games are designed for. A chatbot or mobile application, for instance, is something more accessible with many advantages a traditional computer game doesn't have.

The serious games focusing on security show a greater diversity in the game technologies. While most are also designed as traditional PC-games, some use different technologies such as the Password Rehearsal Games (Forget, Chiasson, and Biddle 2008) for the portable gaming console Nintendo 3DS. The injury rehabilitation game by Fernandez-Cervantes et al. (2015) shows innovative use of the Microsoft Kinect technology, an infrared camera for the XBOX game platforms.

The lack of diversity in technologies used for privacy awareness games shows how immature the field of research is, and that there exists a lot of opportunities already explored by serious games for other domains.

Raised Awareness and Behavioural Change

The user studies and evaluations by Baxter, Holderness, and D. A. Wood (2016), Vanderhoven et al. (2015), Malheiros et al. (2011), and Sheng et al. (2007) on using serious games to raise privacy awareness show very promising results. The studies show that the player does become more aware from playing a serious game for privacy awareness. However, the player doesn't necessarily become more aware from playing a serious game, than from traditional training. Nonetheless, people enjoy playing a game a lot more, and measures can be made to make the serious game more effective, such as having teacher involvement while playing the game.

Even though the games manage to raise awareness on data privacy of the participant, achieving behavioral change is a lot harder, and wasn't accomplished by the games. That behavioral change is harder to achieve than raising awareness is something that is confirmed by several studies (Martens 2010; Mishna et al. 2011; Vanderhoven 2014).

The Concept of Privacy

In section 2.1 a series of conceptualizations of privacy is presented. In the existing games, both privacy as "contextual integrity" and the "privacy calculus" is present. The games focusing on what to share with friends on SNS (Cetto et al. 2014; Vanderhoven et al. 2015) are based on the concept of contextual integrity. In Friend Inspector (Cetto et al. 2014) the player is made aware of which of his friends can see which posts on the SNS -

in other words in which context the content is visible. In Master F.I.N.D[7] the player is a detective, and gains access to information on a fake SNS - taking the information out of the intended context.

The Privacy Game[8] uses the privacy conceptualization of ”privacy calculus”. The player weighs the trade-offs of a privacy-related decision - thereby weighing the pros and cons of the privacy calculus.

The general trend is that games focusing on sharing with friends on SNS often use the concept of contextual integrity. Whereas the privacy calculus, weighing trade-offs, is more apt for serious games raising awareness on other scenarios than social networks.

2.4 Privacy Scenarios

A serious game designed for raising privacy awareness should choose one or more scenarios of which the game should focus on. Privacy is a wide area, and covering all aspects of privacy in one game is going to be a challenge. This section will present the set of scenarios proposed in the specialization project (Berger and Sæthre 2017) that require attention and can be used in the design of a serious game to raise privacy awareness. The set of scenarios is obtained through an iterative process of research spanning across a systematic literature review, media reports[9][10] and other studies and reports (NorSIS 2017). The list is not exhaustive and can be expanded further with new scenarios posing privacy risks.

A concept to consider when designing a SG for privacy awareness is who the information is shared with. Whether to focus on the problem of sharing too much information with friends on i.e. a social network, or sharing too much information with the provider of a service, thus the company. In many cases, the action of sharing with friends is done by actively pressing a share button, while in the situation of sharing with companies, this often happens without the user's knowledge. Table 2.1 shows a mapping of the scenarios by whether they consider privacy when sharing with friends, companies. In both cases the data shared can be abused.

2.4.1 Location Sharing

Location sharing is a privacy concern, as there is an emerging trend of embedding location services into more and more application and services. The user may receive benefits from sharing his location, like the closest bus stop. But some applications may use the location data for other purposes, for instance generating a public profile on the user or selling the data to third parties for marketing purposes. Many people are not aware of the implications

[7] *Master F.I.N.D* (2018). `http://www.childfocus.be/clicksafe/masterfind/`. (Visited on Feb. 14, 2018).

[8] *Privacy Game* (2018). `http://www2.open.ac.uk/openlearn/privacy/game/`. (Visited on Feb. 13, 2018).

[9] *I asked Tinder for my data. It sent me 800 pages of my deepest, darkest secrets* (2017). `https://www.theguardian.com/technology/2017/sep/26/tinder-personal-data-dating-app-messages-hacked-sold`. (Visited on Feb. 14, 2018).

[10] *Forbrukerrådet: Du kan bli avlyttet gjennom disse lekene* (2016). `http://e24.no/digital/personvern/forbrukerraadet-du-kan-bli-avlyttet-gjennom-disse-lekene/23865399`. (Visited on Feb. 14, 2018).

Table 2.1: Types of sharing. What you share with friends, or with the service provider and company.

Scenario	Friends	Companies
Location Sharing	x	x
Smart Cities		x
Activity Trackers	x	x
Health Devices		x
Social Media	x	x
Mobile App Permissions		x
Customer Loyalty Programs		x

of location sharing (Alrayes and Abdelmoty 2016), making it difficult to make informed decisions about whether or not to share their location with a service. In some cases, the user is not even aware that an application is sharing his location and consequently their personal information.

2.4.2 Smart Cities

Smart cities is a growing term and can be described as a collection of vehicles, building and other physical devices with sensor possibilities that exchange data with the same information grid, and uses this data to create safer, cleaner, more sustainable and efficient cities (McLaren and Agyeman 2015). This vast data collection comes with privacy issues for the inhabitants, as devices used for aggregating and transmitting this type of data are often small, with little excessive power to implement security measures, making them vulnerable to cyber attacks (Edwards 2016). A complicating factor for citizens of a smart city comes from the concern that their data is being used for other purposes than they were originally collected for (Zoonen 2016). Additionally, data collected by local government or business today may be abused by future governments or companies, making the surrender of personal data a risk.

2.4.3 Activity Trackers

Activity trackers are popular devices where the user can track his workouts and daily activities in detail, which can include sensitive information such as heart rate and sleeping patterns. This information can be very valuable for third parties, as well as being a target for security breaches as seen in the attack on the activity tracker Fitbit[11]. Another recent happening was the release of the activity tracking app Strava's heat map, revealing the position of remote military bases[12]. Once again proving how people willingly share their personal data without making informed decisions about its implications.

[11] *Online Criminals Are Targeting Fitbit User Accounts* (2016). `https://www.buzzfeed.com/saraspary/online-criminals-are-targeting-fitbit-user-accounts`. (Visited on Feb. 14, 2018).

[12] *Strava Fitness App Can Reveal Military Sites* (2018). `https://www.nytimes.com/2018/01/29/world/middleeast/strava-heat-map.html`. (Visited on Feb. 11, 2018).

2.4.4 Health Devices

Health devices can monitor and help treat conditions. Pacemakers, drug delivery systems and implantable defibrillators and devices can aid patients in a wide range of diseases. Who can access this data? Surely the patient and his doctor, but what about insurance companies? And what about using this data in bigger data sets for analysis? Technological advances in the medical field have been big in recent years, but our understanding of the security and privacy implications of integrated health devices is still very limited (Halperin et al. 2008).

2.4.5 Social Media

Social media are an ever increasing part of people's lives, and sharing private information is easier, faster and more available than ever. The growth in aggregated data combined with the increase in computational power and improved analysis tools have created a billion-dollar industry in collecting and monetizing user data (Oh et al. 2016). The vast accumulation of data makes people unable to keep track of what they share, with whom, and what kind of consequences might ensue. The specialization project uncovered that many students are aware of what should not be shared when actively sharing photos, videos etc., but had limited knowledge of what information that gets stored simply by using a service. The Facebook-Cambridge Analytica scandal is a good example that privacy on social media is an area that requires attention.

2.4.6 Mobile App Permissions

Mobile app permissions decide what data applications can have access to on mobile phones, in order to provide their intended service. Some applications need certain access to function properly, while other apps are "overprivileged" (Felt et al. 2011), meaning that they access more data on the smart device than they need to provide their intended service. Studies have shown that most people are not aware of the digital traces they leave with their smartphones (Braghin and Vecchio 2017). There is a general awareness about the app's access to data from the smartphones, but a low awareness of what the collected data actually can be used for, which depends on the terms and conditions of the service/app.

2.4.7 Customer Loyalty Programs

Customer loyalty programs are marketing initiatives designed by retailers in order to keep customers in their shops or to continue using their services. By tracking user purchases, the retailer is able to offer personalized deals based on user trends, and this data may also be sold to third parties. Whenever sharing personal information with a company, like through customer loyalty programs, there is a trade-off between the value of data shared versus the value of the improved service received for the customer. To weigh these trade-offs the consumer needs more awareness about the value of their data and the possible ways companies can use (and abuse) it.

Scenarios will overlap in many instances. Identifying these dimensions and grouping the scenarios by their characteristics can help game design so that a serious game could be

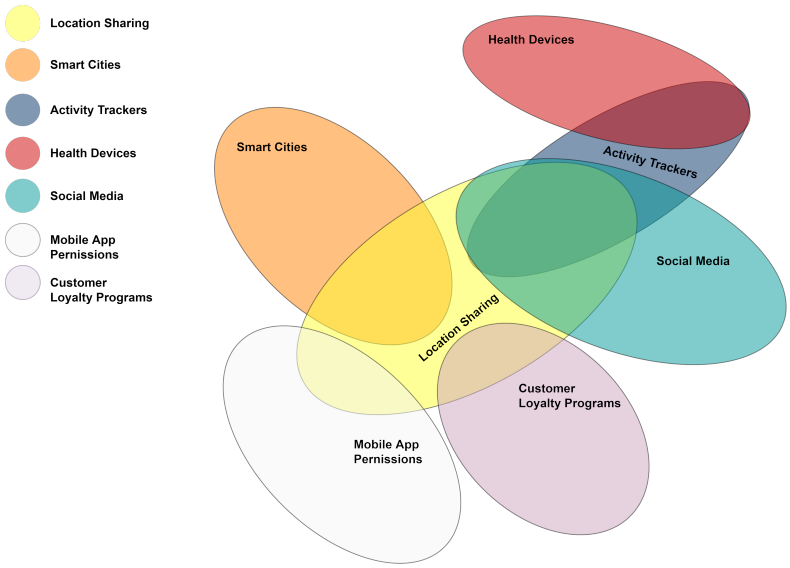

Figure 2.1: Overlapping of the proposed scenarios

created to cover multiple scenarios at once. Figure 2.1 shows how the privacy risks of the presented scenarios overlap.

2.5 Co-Design Workshop User Study

As a result of the lack of diversity in existing serious games for privacy awareness, a co-design workshop was developed as part of the specialization project (Berger and Sæthre 2017), called Privacy Game Co-Design Workshop, (PGCW). The goal of the workshop is to explore which scenarios are relevant and interesting to the participants (teenagers). It is also an excellent way to generate ideas for serious games for privacy awareness, which can be analyzed - and recurring themes can be used as a starting point for designing serious games to raise privacy awareness. A paper explaining the workshop and a user study executing the PGCW with 32 participants is presented in Appendix A. In Table 2.2 (at the end of this chapter) the game concepts of the 9 groups are shown, as well as the scenario the groups chose.

An interesting aspect of the user study involving the PGCW is that the participants chose the scenarios they found to be relevant and interesting problems. In Figure 2.2 the number of times different scenarios was chosen by the 9 groups is shown. The sum doesn't add up to 9 because the groups were allowed to combine multiple scenarios. The most popular scenario category is "Social Media". This shows us that even though the scenario of what to share on Social Media has received the most attention in existing literature and games, the participants still believe it to be an interesting and relevant scenario to design

for in serious games to raise privacy awareness. Interestingly, not all the scenarios with Social Media was related to what to share and not to share with friends. Multiple groups considered what the user shares with the social media service itself just as problematic. The second most selected scenario is ”Smart Cities”. The participants see the scenario of privacy concerns in a smart city as an interesting aspect to focus on for a serious game to raise privacy awareness. Another reason for the popularity of this scenario was that the participants believed that games where the player is exploring a smart city to be a fun and engaging game.

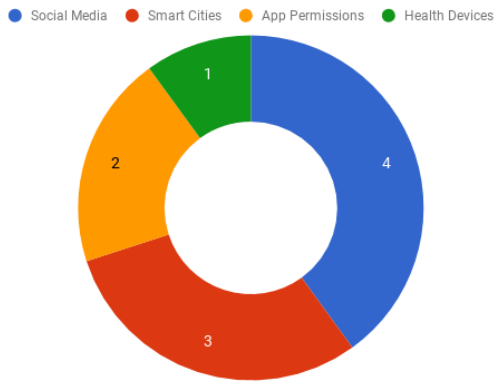

Figure 2.2: Scenarios chosen by participants in the user study

The goal of the serious game ideas in the workshop is to raise the awareness of the player around digital privacy risks. In the ideas from the user study, a recurring theme to raise the awareness of the player is to let the player choose his own actions, and then seeing the consequences of said actions. In doing so the player may either rewarded or ”punished” for making correct or incorrect decisions. Another reappearing element to increase the awareness of the player is to allow him to see things from an attacker point of view. In doing so, he will be able to see the actual value of personal information. This way to raise privacy awareness is closely related to the privacy conceptualization ”privacy calculus”, which states that all privacy-related decisions are a trade-off - often between receiving an improved service vs. providing personal information. By seeing things from the information-abuser point of view, the player may become more aware of the value of his personal information and thus make better, more well-informed, decisions when a privacy risk is involved. In cybersecurity taking the point of view of an attacker is no new concept. This practice is often called ”Red Team” and is an advanced form of assessment used to identify weaknesses in systems by simulating adversaries such as hackers (Schudel, B. Wood, and Parks 2000).

Surprisingly few of the game ideas have a traditional educational perspective, like teaching the player about privacy through informational text, videos or in a quiz-like manner. According to the privacy calculus, having increased knowledge will lead to better decision-making when weighing trade-offs, and therefore an increased awareness. It can appear the participants consider this way of raising awareness too conventional and alike

classroom teaching methods.

A recurring game type observed in the game ideas from the participants of the workshop was the adventure open world game, where the player can roam freely and interact with anyone and anything in the game world. Depending on the actions chosen by the character in these interactions the game could evolve in different directions. Despite drawing different game types, the final game design often developed into adventure or exploration game, where the player's action would affect how the game evolved. Another aspect that came again in the ideas was the use of humor as a tool to engage the player and increase awareness. This can be in the form of witty character dialogues or other funny elements, and must be balanced so as not to "overdo it".

2.6 Chatbot game to Raise Privacy Awareness

This chapter has presented problems with the current state of the privacy awareness among teenagers today, some of the limitations in the existing serious games for privacy awareness, several privacy scenarios that require attention, as well as recurring themes in game ideas from a user study using the workshop PCGW to co-design serious games for privacy awareness.

We believe a serious game in the form of a chatbot can solve many of the problems presented. Therefore the main research question in this master thesis is:

> **RQ1**: How can chatbots be used in adventure-based serious games to raise awareness of data privacy risks?

There are several reasons as to why chatbots in serious games are worth exploring. As a part of the user study presented in Appendix A, the participating teenagers answered a questionnaire documenting the digital services they use - and the most used service, with 100% of the participants, was Facebook Messenger (see Figure 2.3). Thus teenagers are already using messaging services extensively, and incorporating serious games is therefore worth researching. A chatbot can be accessed on multiple channels and can be interacted with on several platforms - both computer and mobile. This makes it more convenient for the player, not being restricted to one specific technology to play the game. As mentioned in the introduction, chatbots are able to offer a simplicity and personalization factor that outperforms many mobile, web and other applications.

Advances in Natural Language Processing (NLP), machine learning and big data have contributed to making chatbots better and easier to develop (Lebeuf, Storey, and Zagalsky 2018). Major software companies also recognize the value of chatbots, and Facebook has stated that they aim to "replace apps with chats"[13]. Microsoft is heavily invested in chatbots with Microsoft Bot Framework[14] and has stated that "conversation as a platform is the OS of tomorrow"[15].

[13] *Can Facebook Messenger kill off apps?* (2015). `http://www.telegraph.co.uk/technology/facebook/11996896/Can-Facebook-Messenger-kill-off-apps.html`. (Visited on Feb. 19, 2018).

[14] *Microsoft Bot Framework* (2018). `https://dev.botframework.com/`. (Visited on Feb. 19, 2018).

[15] *Conversation as a Platform* (2016). `https://channel9.msdn.com/Events/Build/2016/C902`. (Visited on Feb. 19, 2018).

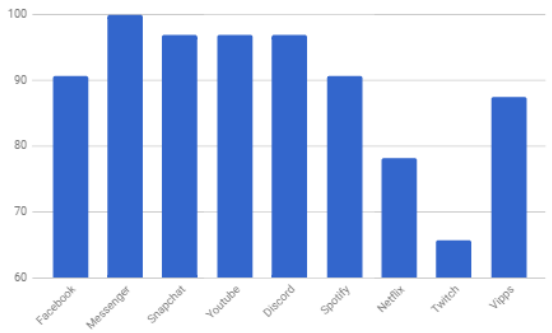

Figure 2.3: Top 9 most used digital services. Represented as % of participants.

This recent focus has shown new evidence of the value of using chatbots to tailor the game to user behavior, demographics, and needs. Chatbots offer a simplistic, intuitive nature based on text with little UI complexity (Fadhil and Villafiorita 2017). As companies, such as Facebook, have devoted resources and time to be platforms for chatbots they now offer many capabilities that weren't an option to chatbots in the past. The Facebook Messenger Platform[16] offer opportunities to implement UI elements like buttons, menus, lists, and even receipts directly into the user chat to further guide user behavior (see Figure 2.4).

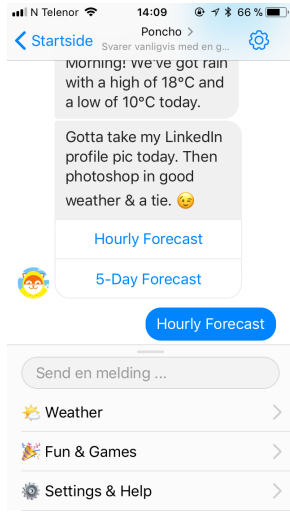

Figure 2.4: Conversation with Poncho[17], showing UI elements menu and buttons. Poncho is a chatbot made by Facebook to show some of the chatbot possibilities on the Messenger platform.

[16] *Facebook for developers - Messenger Platform* (2018). `https://developers.facebook.com/docs/messenger-platform/`. (Visited on Feb. 21, 2018).

[17] *Hi Poncho* (2018). `https://www.messenger.com/t/hiponcho`. (Visited on Feb. 21, 2018).

Studies (Kiili 2005; Ravyse et al. 2017) have shown that players do not require audio-visually rich games to be effective learning tools. Chatbots have previously been used in serious games to some degree, like the game CiboPoliBot presented by Fadhil and Villafiorita (2017), which aims to teach children about a healthy lifestyle. In Chapter 3 several existing serious chatbot games are presented - both games which is a chatbot itself, as well as games utilizing chatbot technology to enhance an existing serious game.

2.6.1 Engaging the Player

Unlike traditional games, the primary goal of a serious game is not to entertain, but to educate, motivate or promote behavioral change. However, it is still very important to engage the player in the serious game. For the game to be successful in it's "serious" aspect, studies show that first the player needs to have fun (Ravyse et al. 2017). Thus, one of the main success factors for a serious game is to not impede this hunger for fun, but rather stealthily use it to engage the player in the learning material.

In chatbot serious games, the novelty of a chatbot can work engaging in and of itself. Interacting in a new and exciting way can add entertainment value to the game, and keep the player's interest. However, this will likely not keep the player sufficiently engaged throughout the entire game. Therefore we will explore what other game elements can be used in chatbot serious games to further engage the player. The player can get engaged in the game by elements like an interesting story, the possibility to explore, and seeing how actions can change the world and have consequences. These are typical intrinsic values that engage the player. Intrinsic motivation involves engaging in a behavior because it is personally rewarding; essentially, performing an activity for its own sake rather than the desire for some external reward (Cherry 2018). This is in contrast to extrinsic motivation, where the player is playing to get a reward or avoid punishment - for instance getting points for answering a quiz correctly. What engages the player depends on what kind of user he is - some players are more motivated by social competition or collaboration with other players (Tondello et al. 2016).

Having an immersive game with excellent 3D graphics and sound is a great way to engage the player. However, this is not very relevant to chatbot serious games which rely on a textual interaction and a simple user interface. Furthermore, it is expensive to develop impressive graphics, and players have high standards and expect games to be as audio-visually realistic as possible (Visschedijk and Van der Hulst 2012). Therefore we must explore other ways to engage the player. Having run the PCGW user study (Appendix A), we have already included the target audience (teenagers) in the design process of the serious game. As explained in section 2.5, recurring themes in the game ideas point towards engaging the player with an interesting adventure-based story where the player explores a world, as well as letting the player choose his own actions and then seeing the consequences of said actions. Accordingly, we will explore how these game elements can be used in chatbot serious games, as well as other elements which may further help engage the player in the game - such as adding extrinsic motivation in the game.

A concept used to evaluate the enjoyment of a game experience is Flow. Flow was first introduced by M. Csikszentmihalyi (1975) and describes the optimal experience or a state where a person is so involved in an activity that nothing else matters. The concept

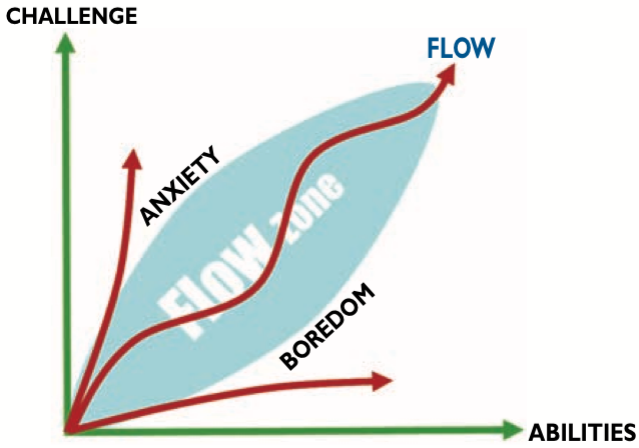

Figure 2.5: The concept of flow. To achieve flow, there is an ideal balance between how challenging a task is versus the ability of the player. (J. Chen 2007)

is applicable across multiple fields, and the fundamental part of flow is to balance the inherent challenge and the player's ability to address and overcome said challenge (J. Chen 2007). A visual representation can be seen in Figure 2.5, where an ideal balance of challenge and ability will lead to the state of flow. A too challenging task, compared to ability, will lead to player anxiety, while a too simple task will lead the player into a state of boredom. Game designers must reflect on creating a game that keeps players in the right balance throughout their experience in order to keep them in the zone of flow. Additionally, different players possess different skills and need different challenges, and it is therefore important to consider adaptive experiences to make the flow zone available to a broader audience.

2.6.2 Raising Awareness of the Player

Once the player is engaged in the game, one has to look at how to achieve the "serious" aspect of the serious game. Just like there are many ways to engage the player in the game, there are many ways to enhance the learning outcome for the player. In this context, the "learning outcome" is whatever the purpose of the serious game is - be it education, behavior change or an increased skill. Ravyse et al. (2017) makes claims that one of the success factors for a serious game is that the narrative of the story should be linked to the learning material, and that an unrelated narrative may diminish the learning outcome for the player. As we will look at how to use a narrative-driven adventure chatbot game to raise awareness, this is especially relevant. Additionally, many other game mechanics exist to enhance the learning outcome; such as reward systems for displaying correct behavior, providing factual information to the player throughout the game, having a debriefing after the game to review choices made during the gameplay, and many more.

We will explore which game elements and mechanics can be used in chatbot serious games to enhance this learning outcome success, focusing on raising the privacy aware-

ness of the player. Just like adventure is a recurring game theme in the game ideas from the PCGW results, so is the game mechanic that choices made within the game have consequences and help shape the story of the game - providing multiple ways to play it. In this report, we will examine if this is a viable way to raise awareness, as well as identify and look at other game elements which can be used in a chatbot serious game to enhance the learning outcome and privacy awareness of the player.

Table 2.2: Table showing the cards the different groups selected/drew and the game concepts they ended up with in the PCGW user study (see Appendix A).

Nr	Scenario	Play	Technology	Game concept
1	Social Media	Strategy	Augmented Reality	The player explores the real world, and using his phone with AR he can hack the information of virtual companies. To excel, this information can be traded for money and other goods.
2	Social Media	Shooter	Virtual Reality	Your job is to explore the world and detect fake profiles on Tinder. By using a shotgun you exterminate the fake users one by one in a humorous way.
3	Social Media	RPG + Adventure	Virtual Reality	In a VR world the player takes pictures of objects and post them to social media. This can give the player fame, or have grave consequences if wrong picture is posted.
4	Smart Cities	Survival Horror	Console	The player must survive in a smart city using stealth to not be detected by the government or hacked.
5	App Permissions	Survival Horror	Computer	A puzzle game where the player give permission to all his personal information. If he doesn't finish the puzzle everything is posted to social media.
6	Smart Cities	Adventure + Survival Horror	Console	"Revolution" is a game where the state has gathered a lot of personal data about the player in a post apocalyptic setting, and the player must prevent them from abusing it.
7	Health Devices	Platform	Computer	Open world game, player is prompted about sharing private information. Can interact with other people to learn from their mistakes.
8	Social media + App Permissions	Adventure	Computer	The player discovers that an SNS uses private information illegally, and must decide what to do in a decision based game.
9	Smart Cities	Action	Computer	First person stealth game, where the player attempts to infiltrate and take down an "evil" organization that abuses personal data without giving away data about oneself.

Chapter 3

Related Work

In order to get a better understanding of important factors of the serious game to be created, we perform a literature review.

In the specialization project (Berger and Sæthre 2017), a systematic literature review was conducted with a focus on existing serious games for raising privacy awareness. In this report, the focus is shifted towards how *chatbots* and the game type *adventure* has been used in serious games previously. Additionally, we explore *Consequential play*; how consequences of actions are used to raise awareness of the player - a recurring theme in the user study co-design workshop results (see Appendix A).

As explained in section 2.6.1, for a serious game to be successful in its desired learning outcome (education, behavior change, increased skill, etc.) it is vital to be able to engage the player in the game. Therefore, the two main goals of this review are to explore how specific game elements to engage the player and game elements to increase learning outcome has been used in previous approaches in chatbot and adventure-based serious games. This will help answer the sub research questions **RQ1.2** "How can chatbot serious games engage the user?" by identifying engagement elements, and **RQ1.3** "How can chatbot serious games raise awareness?" by identifying learning elements. In addition to these main goals, the review will compare the technologies used in chatbot serious games and the main purpose of the games.

Section 3.1 explains how the search was conducted to find relevant literature, and in section 3.2 the results are presented, identifying the engaging and learning elements. As a part of the results, section 3.2.1 explores how chatbots have been used in serious games in literature, section 3.2.2 adventure-based serious games, and in section 3.2.3 it is analyzed how consequential play has been used.

3.1 Literature Review: Method

The review was done in a quasi-systematic manner where a search query was first selected, and articles were included based on their title and abstract. Some articles were later excluded if deemed not relevant. In this report, we only present the publications that were

included and deemed relevant by the authors.

3.1.1 Data Sources and Search Terms

The articles were searched for and collected from different online databases relevant to the field of Computer Science. For the query based search the following databases were used: ISI Web of Science[1], ACM digital library[2], Elsevier - ScienceDirect[3], Elsevier - Scopus[4], IEEE Xplore[5]. In addition to the mentioned online databases, the search engine Google Scholar was used to find additional papers which weren't included in any of the mentioned online databases.

We chose to employ broad terms for searching the online databases when looking for serious games. The reason for this is that after conducting several test searches, the number of hits was too low. Thus, when searching for serious games the following search terms were used as a base:

> "serious games" **OR** "games-based learning" **OR** "simulation games" **OR** gamification **OR** edutainment **OR** "educational games" **OR** "games for learning"

This was combined with other terms when looking especially for chatbot serious games, or adventure-based serious games. The additional search terms are discussed below, where relevant.

3.2 Literature Review: Results

3.2.1 Chatbots in Serious Games

Chatbots is no new concept, yet it hasn't been explored how chatbots can be used for raising privacy awareness. This section will examine how chatbots have been used in serious games in existing literature. To find the literature on existing chatbot serious games, a query based search was conducted in the fore-mentioned databases. A pattern in the search results is that it is only in recent years that the literature has agreed on the term "chatbot". In earlier years these systems were usually referred to as "conversational agents". There has also been some confusion as to how to spell "chatbot", as "chat bot", "chat-bot" and "chatterbot" are terms used to describe the same system. To account for all of these variations of chatbots, the following was added to the base search query presented earlier in this chapter:

> **AND** (chatbot **OR** "chat bot" **OR** "chat-bot" **OR** chatterbot **OR** "conversational agent")

[1] *ISI Web of Science* (2017). `https://apps.webofknowledge.com/`. (Visited on Sept. 25, 2017).
[2] *ACM digital library* (2017). `https://dl.acm.org/`. (Visited on Sept. 25, 2017).
[3] *ScienceDirect* (2017). `http://www.sciencedirect.com/`. (Visited on Sept. 25, 2017).
[4] *Scopus* (2017). `https://www.scopus.com/`. (Visited on Sept. 25, 2017).
[5] *IEEE Xplore* (2017). `http://ieeexplore.ieee.org`. (Visited on Sept. 25, 2017).

The search returned 62 results, and literature was chosen based on the title and abstract relevance, citation count, and recentness. The main requirement for inclusion was whether the game could be identified as a chatbot serious game, or that a chatbot was a part of the game.

Chatbot Serious Games

CiboPoliBot presented by Fadhil and Villafiorita (2017) is an educational chatbot game specialized in teaching children about a healthy lifestyle. The game is based on a paper prototype "teaching primary school students about healthy diet and food waste management". The goal of the game is to collect a right combination of fruit, grain, vegetable, dairy, and protein. The player tosses a dice and has to make decisions as to if he will collect or throw away food, i.e. an apple. Additionally, the player will encounter quizzes along the way, where he gets points for answering correctly. In the end, the player with the most correct combination of food as well as most points wins the game. The game incorporates a leaderboard and points as the main game mechanics to engage users in the gameplay. These game mechanics were chosen by the researchers as a result of using the Hexad model of gamification by Tondello et al. (2016) to identify the user types and map them with game design elements. The entirety of the game happens on the messaging platform Telegram[6], and the game is mainly conversational driven, with simple UI elements like buttons and pictures to help guide the player. One of the strengths of CiboPoliBot is the personalization offered by using a chatbot as the serious game. With an underlying AI, chatbots are able to offer "the simplicity and personalization factor that outperforms many mobile, web and other forms of applications". The technology behind the chatbot game is based on Microsoft Bot Framework, uses API.ai (now called Dialogflow[7]) for NLP and bot-intelligence, as well as Telegram Bot Framework to achieve a customized UI with buttons and custom keyboard.

Othlinghaus and Hoppe (2017) present the game CuCoMag. This is a chatbot serious game designed for the training of customer complaint management in electronic shops. In the game, the player assumes the role of an employee responsible for customer service in a shoe online store. The chatbot is simulating a customer who reports a certain problem. The player responds to the complaints using a combination of pre-defined sentence openers and free text, trying to solve the problem for the "customer". The player is automatically scored according to his communicative behavior on factors like politeness, message time, aggressiveness, etc. Supplementing the chatbot game is a tool for supporting group reflection in an after-action review to help the players identify and share elements from the experience. After multiple players have completed the (singleplayer) game, they join the group reflection session together to see on which factors they scored high or low scores, and can see transcriptions from the chats together with an expert. This group reflection tool is not a chatbot, but a traditional web-interface. The technology behind the CuCoMag chatbot game is Artificial Intelligence Markup Language (AIML), using a simple pattern-matching mechanism. Evaluating the performance of the player is done by a multi-agent system. The chatbot is not available on typical chatbot-friendly platforms like Telegram

[6] *Telegram Messenger* (2018). `https://telegram.org/`. (Visited on Feb. 21, 2018).

[7] *Dialogflow - Build natural and rich conversational experiences* (2018). `https://dialogflow.com/`. (Visited on Feb. 21, 2018).

(where i.e. CiboPoliBot lives), Facebook Messenger or Slack, but rather in a stand-alone web-application developed by the authors. This allows full customizability for the developer, but increases development cost significantly by not being able to take advantage of the built-in capabilities of the chat-platforms like UI elements, as mentioned in section 2.6.

The game Communicate! by Jeuring et al. (2015) is a serious game for practicing communication skills for healthcare professionals, such as doctors or psychologists. The player selects a scenario and holds a consultation with a virtual client. In the consultation, the player chooses replies between various options. After selecting a reply, the player gets immediate feedback from the chatbot "client" and can see if his reply was the correct one. The client responds with text, but is also represented by a virtual character that shows emotions as feedback to the conversation. The replies are scored across multiple learning goals, for instance empathy and clarity of the answer as a psychologist. This is very similar to how scoring of the answers is done in CuCoMag (Othlinghaus and Hoppe 2017), across multiple factors. After the game, the player gets to see his scores on the learning objectives in the scenario, as well as textual feedback on the conversation choices he made. The game doesn't identify itself as a chatbot, but the main gameplay of the serious game is clearly a chat with a virtual character - or a bot if you will. The player doesn't reply with free-text, only pre-defined responses, making the game rather simpler than other chatbot serious games.

In the paper by Rosmalen et al. (2012), it is explored how to extend, or rather replace, the interaction in the existing serious game EMERGO with a chatbot. The gameplay is, like in Communicate! (Jeuring et al. 2015), a chatbot conversation with a healthcare professional - this time a sexologist, with the objective of teaching basic sexology. The target group of the game is psychology students taking an introductory course on sexology. The chatbot is designed to understand 90 different questions in the field of sexology. If the question is understood by the chatbot, it replies by showing a pre-recorded video of a sexology expert answering the question. When the conversation is over, the chatbot summarizes the conversation, listing the questions discussed, and shows a list of important questions that the player didn't ask - allowing them to choose one more from the list. The technology of the chatbot is based on an AIML knowledge base (responsible for understanding the 90 questions), and the chat platform is incorporated into the existing EMERGO game through a custom web application.

Vaassen and Daelemans (2010) explore how to classify the emotions of the player on the Leary's Rose (Leary 1957) scale in order to improve his communication skills. In the game, the player interacts by typing written sentences with a chatbot in scenarios specified to improve interpersonal communication. The target group is adult workers as a part of communication training in a professional context, for instance negotiations. The player needs to figure out what conversation tactics work best in order to achieve his goal, thus becoming a better communicator.

Chatbots as an Element in Serious Games

In addition to the above mentioned serious games where the game itself is a chatbot, a variety of serious games also exist which incorporates the chatbot into an existing game, providing an interesting game mechanic. Oftentimes the chatbot is one or more non-playable characters (NPC), which the player has to interact and converse with at some

point in the game.

Solis Curse by Neto et al. (2011) is a serious game accompanying a cultural heritage exhibition in Portugal. The game is a 3D world of historic scenery where the player is trying to build a model of Pantheon, and the goal of the game is to test the knowledge acquired during the museum visit. This is done by answering quiz-questions correctly, and then moving on to the next level. The game is accompanied by a narrator, which is a chatbot. The narrator provides a lot of historical information relevant to the quiz, as well as presenting the quiz questions. The player can answer the quiz either by touching the right answer on a screen, or by saying the correct answer out loud. By answering correctly and quickly, the player accumulates points and after the quiz, the player is shown a high score leaderboard. The narrator has a "personality", establishing empathy towards specific audiences. Technology-wise, the chatbot narrator character was modeled in 3D Studio Max, and AUDIMUS for automatic speech recognition which relies on hidden Markov models for pattern classification. At the time (2011), the chatbot technology alternatives were limited and a lot of the AI and NLP logic had to be made specifically for the chatbot.

Depending on the game type, the communication with NPC is often essential for supporting the game plot, as well as making the artificial world more immersive. Several games have explored how to use natural language processing to interact with these NPCs, thus making the NPC a chatbot itself, a part of the game. Klüwer et al. (2010) presents KomParse, a system to have natural-language dialogues with chatbot NPCs. The player can chit-chat with a bartender, or a furniture salesman to help the player furnish his virtual apartment. S. Barab et al. (2012) explore how conversation with NPCs in the game Quest Atlantis can be used to teach persuasive writing. One of the main aspects of the serious game is that the player can see the consequences of his actions come into play in the game. A user study is also conducted, showing very promising results on using a serious game approach with chatbot NPCs in comparison with more traditional education. In the game by Bernsen et al. (2004) a conversational character tells fairytales by H.C. Andersen to the player, as well as reacting emotionally to the user input - i.e. happy if the player likes to talk about a fairytale. The storyteller also provides factual information to the player, as well as entertain through conversation.

3.2.2 Adventure-Based Serious Games

Adventure games (or narrative games) are described as games in which the player assumes the role of a protagonist in an interactive story driven by exploration and puzzle-solving (Rollings and E. Adams 2003). Alongside quizzes and simulations, it is also the most common type of serious game, as reported in theoretical overviews (Granic, Lobel, and Engels 2014) and studies of games for learning (Connolly et al. 2012).

To examine the use of adventure type serious games, the following was added to the base search query for serious games presented earlier in this chapter:

AND Adventure

The search returned a plentiful amount of results, and articles were chosen based on the title and abstract relevance, citation count, and recentness.

D. M. Adams et al. (2012) consider two hypotheses related to narrative-based adventure games; the discovery hypothesis and the narrative hypothesis. They present cases

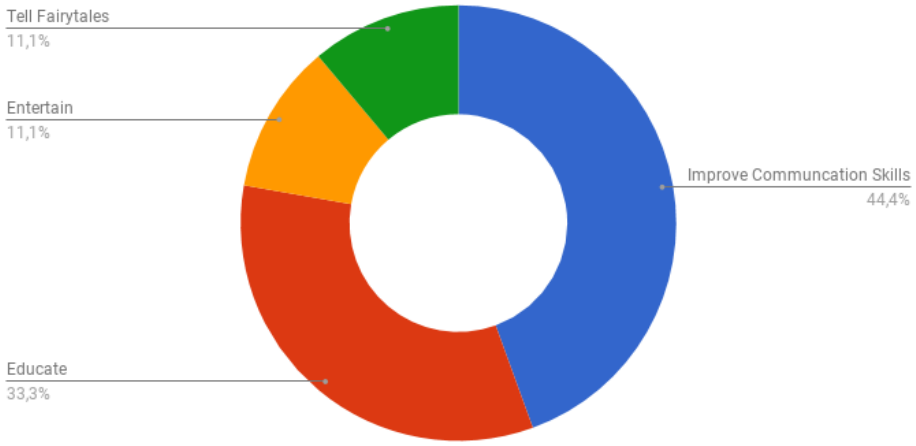

Figure 3.1: Main purpose of the chatbot serious games discussed.

for and against, before conducting a media comparison and value-added approach (R. E. Mayer and Johnson 2010; R. E. Mayer 2011) to test the hypothesis predictions.

The discovery hypothesis proclaims that students learn more when they can actively explore a learning environment than when they are told what they need to know. Contradicting the discovery hypothesis is the problem of distraction, saying that the student gets distracted by game material or activities that are not directly related to the instructional objective. This is supported by the cognitive theory of multimedia learning (R. Mayer 2009), and cognitive load theory (Sweller 1999), saying that learners can only process a limited amount of information in working memory at any given time. Processing capacity spent on getting familiar with game mechanics will then leave insufficient capacity for learning the intended material. The media comparison experiment by D. M. Adams et al. (2012) left no support for the discovery hypothesis, as the students learned significantly better watching a slideshow containing the same information as the game.

The narrative hypothesis claims that adding narrative to educational games can help organize the learning material, making it easier for the student to remember intended material, as proposed by Graesser et al. (1980). Narratives are also suggested to be easier to understand as well as increase interest, while also being considered a vital engaging element in regular computer games (Lee, Park, and Jin 2006; Marsh 2010). The mentioned distraction view is opposing the hypothesis, saying that the limited working memory will allocate space to a compelling storyline instead of the actual learning goals. In the experiment conducted by D. M. Adams et al. (2012) students are compared playing the same game, where one group played the game with a strong narrative theme, while another group played the same game without a narrative. Results showed that the two groups had no significant difference in learning outcomes, furthermore there was a slight trend towards the narrative group enjoying the game slightly more than the group without a narrative.

D. M. Adams et al. (2012) discuss further why the narrative hypothesis did not increase learning, noting that the narrative theme in the experiment was unrelated to the learning

objective, not leaving the story as a useful cognitive tool of which to organize material and increase coherence between facts.

D'Apice et al. (2015) describe a set of necessities for designing an Educational Adventure Game where number 4 and 5 is added to accommodate for the educational part of the game:

1. The story to narrate
2. The world the protagonist explores
3. The puzzles the player must solve
4. Which learning contents to convey and the most effective way to convey them
5. Strategies to assess the player performance

The paper also presents the SG SIRET Security Game, created to teach principles of information security to public administration and company workers and help them take responsibility and understand that company safety depends on them. The player takes the role of Harry, the "Hero", and solves quests and defeats villains with the help of his mentor and security officer. The paper, in similarity to the one by D. M. Adams et al. (2012), notes the importance of a game setting that simulates relevant places with problems of the real world in order to help the player relate and maximize educational outcome. The game uses different strategies to convey learning content: in-game book objects can be picked up and contains detailed information, pictures and texts in cutscenes[8], interactions with NPCs, and sets of procedures that the player is asked to follow in order to achieve a goal. Additionally, the player receives a journal, a personal notebook containing all quests as well as a summary of all the concepts the player has been presented.

Players of SIRET are assessed using In Process Assessment (S. Chen and Michael 2005) which they claim is well suited for the adventure game genre. This is done by inserting triggers in the game that goes off when the players interact with a specific object, or if a variable reaches a certain value. If a player is struggling, the game notices and the mentor provides the player with hints to help progress. The mentor provides hints of three different categories: Better explained question, hint of how to solve the task, or a step by step guide to completing the task. The first example will not give point penalties, while the second and third will respectively penalize the player small and significantly. Thus, the game adapts according to the progress of the player.

Riemer and Schrader (2015) aim to develop and test a measurement of students' attitudes, perceptions, and intentions to learn with serious games, as well as discover any differences between the three most common SGs: Quiz, simulation, and adventure. Their results show that attitude as an overall evaluation of learning with games, does not differ across the game types, but also note that quizzes and adventures induce a greater positive effect as compared to simulations.

The study by Pilegard and Richard E. Mayer (2016) investigates if adding a pre-game and in-game worksheet to an adventure game can enhance learning outcome for the player.

[8] *Cutscene* (2018). `https://en.oxforddictionaries.com/definition/cutscene`. (Visited on Feb. 22, 2018).

Their rationale for including said sheets is to increase appropriate cognitive processing aimed at the instructional objective, while still keeping the motivational aspect of the adventure game. As discussed by D. M. Adams et al. (2012), the limited cognitive resources must allocate a sufficient amount to processing the learning material. The pre-game sheet asked the player to write an explanation of how a wet-cell battery worked, while the in-game worksheet requested the player to explain how to build a wet-cell battery in the game. The game used is Cache-17 (Koenig 2008), a first-person, 3-D, narrative discovery learning game, created to teach concepts of electric circuits. In an experiment, two groups were given Cache 17, while only one of the groups were handed the worksheets. Results from 23 participants concluded that the addition of worksheets positively improved learning outcomes, without affecting students' reported enjoyment of the game. A takeaway from the study is that learning games can be improved by adding material that does not alter the game itself.

Dickey (2011) describe the game Murder on Grimm Isle, a multiplayer 3D interactive environment where learners move through an environment to collect evidence. A wealthy attorney has been found dead and it is up to the player to gather evidence and determine the murderer, using the evidence to support their arguments, as there is no correct answer. The purpose of the game is to educate the player in persuasive writing. The game was tested with 20 participants playing the game in the same laboratory, being allowed to communicate both aloud and by using the game chat. Post-game discussions reported that most participants, despite not enjoying writing papers, found the game as an enjoyable experience for teaching persuasive writing. As previously discussed by Thomas W Malone (1981) and Provenzo Jr (1991) the importance of curiosity in game design was supported in this paper, stating that curiosity played a vital role in the participants' perception and engagement in Murder on Grimm Isle.

Morsi and Mull (2015) present the game Digital Lockdown, a 3D educational adventure game designed to educate the player in the areas of number systems, Boolean algebra, and combinational logic design. The game takes place on a space station that has been placed on a lockdown due to a failed AI project that left the station in the hands of AI drones, and it is up to the player to save the station through the use of skills in various engineering aspects. At the end of each of the two levels, an end-game summary of player performance is presented. The game has yet to be evaluated.

Hou and Li (2014) discuss the game Boom Room, a game for increasing knowledge about computer assembly, its learning effectiveness, acceptance of the game, and flow experience - a concept used to describe the player's psychological state during the course of playing the game. Boom Room is an educational adventure game, where the player must collect hardware and assemble a desktop computer in order to disable a bomb and escape a room within 10 minutes. A major finding of the study is that the various dimensions of flow experienced by the students were significantly correlated with game acceptance, revealing that appropriate challenge levels and clearly defined game goals may increase the acceptance of the game by the students. Study results showed that knowledge of the students was not raised, and the paper looks to time limitations (the student were only allowed to play the 10-minute game once) as the main reason, as only 10% were able to finish the game. Only one attempt, and a 10-minute time limit left most students spending their time familiarising with game mechanics, instead of learning about computer assembly.

The paper concludes with suggestions for game designs and instructional practices. With the discovered relation between flow and game acceptance, a suggestion to ensure the player's flow state is by using scaffolding, in the form of prompts of hints, to help the player through overly difficult game parts. A second suggestion is that it is important to give the player a sufficient amount of time to play the game in order to become familiar with game operations and mechanics, and be able to play the game multiple times to reflect on their actions and results. Lastly, the paper discusses the importance of creating a game with a high usability user interface.

3.2.3 Consequential Play

To see the impact of your actions on the world, truly becoming an active participant in the game, is an interesting way to influence the player explored by several serious games. The idea is that what you do and what you know become directly linked to your game involvement and the story of the game. This can be both engaging to the player, as well as be used to educate, motivate or raise awareness about a topic.

S. Barab et al. (2012) explore how to teach persuasive writing by having natural-language dialog chatbot NPCs. The idea behind this game is **transformational play**, which is based on consequential engagement (Gresalfi et al. 2009). In transformational play, the player becomes an active protagonist who must understand and employ conceptual understandings to understand and make choices in order to effectively change, and possibly solve, problematic scenarios (S. A. Barab, Gresalfi, and Ingram-Goble 2010).

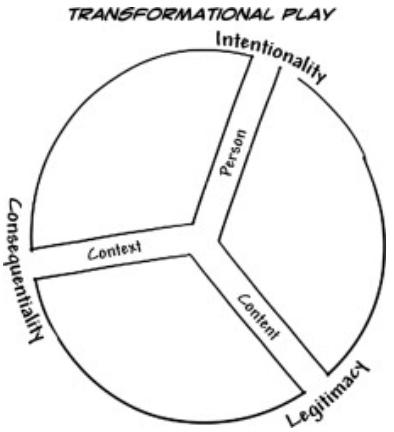

Figure 3.2: The core elements of transformational play: person with intentionality, content with legitimacy, and context with consequentiality. (S. A. Barab, Gresalfi, and Ingram-Goble 2010)

As seen in Figure 3.2, the idea of transformational play can be divided into three main components. Person, content, and context. Person is the concept that games allow the player to explore new areas, engaging in experiences he would never have in the "real world". With fictional gameplay, the imagination is pushed and suddenly a 17-year old is responsible for making sure privacy is maintained in an entire smart city, deciding the

fate of the community. Beyond this imaginative gameplay is the *consequentiality* as the impact of his choices changes the game world, providing subsequent storylines and a rich narrative (Jenkins 2004). The actions of the player not only has an impact on the world around him, but also have consequences for the player - changing his status and what he can accomplish in the world (i.e. a new tool). What makes this context and content powerful for an educator is that the game can allow the player only to progress if he is able to employ new knowledge and academic understanding of a concept to a scenario. Thus, the player must *intentionally* make knowledgeable decisions. An example of this by Gresalfi et al. (2009) is that the player must use his knowledge of pollution to understand whether and why the water quality in a park is deteriorating. This example both shows the utility of the learned concepts, but also lets the learner regard himself as capable of applying meaningful content. The content of the game needs to be *legitimate*, that is having real scenarios that the player can relate to - such as the ones presented in section 2.4.

The specific game scenario presented by S. Barab et al. (2012) is that the village of Ingolstad is facing a terrible plague. The players meet a doctor who might be able to cure the plague by creating a (possibly dangerous) experimental creature. The players use their persuasive writing skills to convince the village people (NPC chatbots), save the village, and deal with ethical dilemmas along the way. The players experience consequences of their actions in several ways. According to the player's decisions, the NPCs treat the player differently. I.e. the policeman is unfriendly if they have allowed the doctor to continue conducting dangerous experiments. How the player chooses to deal with the plague also has consequences for the game narrative; if he allows the doctor to conduct his experiments and create the creature the plague will be exterminated, however the player then has to deal with the dangerous creature. If the player doesn't convince villagers to allow the doctor to continue experimenting, the town is overrun by the plague.

In addition to presenting the game, S. Barab et al. (2012) conduct user a study evaluating the persuasive writing game on measures of player engagement and learning gains, as well as comparing the results to teaching the same curriculum in a traditional classroom learning context. The player engagement was measured by a version of Nakamura and Mihaly Csikszentmihalyi (2014) questionnaire. 86% of the students playing the game enjoyed the activity, whereas only 22% of the traditional-education group enjoyed it. The motivation for completing the tasks for the game group was that they wanted to do it - thereby enjoying the learning activity. The motivation for the traditional-education group was that 95% did it because their teacher told them or they wanted a good grade. Learning gains were measured by doing a pretest and posttest created by the teachers to measure skills in persuasive writing. Both groups showed serious learning gains, but results show that the game-group had significantly more learning gains from playing the consequential serious game than the group doing traditional education.

Gresalfi et al. (2009) present a game designed to teach young students aquatic natural science. The storyline is that a virtual park called "Taiga Park" is facing a problem that has led to a decline in fish numbers in the waters, resulting in a drop in park revenue from visiting fishers. The player learns about science and water quality and has to employ this knowledge to save the park. The narrative of the game is revealed over time based on the choices the player makes. In this way, the actions of the player have consequences

for how the story unfolds, and is a way to both engage and educate the player. The game is evaluated in a user study involving fourth-grade students as participants. The players showed significant learning gains, as well as a rich perceptual, conceptual and ethical understanding of science. One of the main factors contributing to the positive results was the immersive narrative in the game, which was ever-changing based on the actions of the students.

3.3 Discussion

3.3.1 Chatbot Serious Games

Game Main Purpose

When looking at the literature for chatbot serious games, there is a majority of games with the learning goal of improving communication skills of the player (see Figure 3.1), which is considered a soft skill. This is not very surprising, as the capabilities of a chatbot allow the player to actually *communicate* in natural language with the game, a possibility not offered by many other game technologies. Raised privacy awareness is not a communication skill, but the communicative nature of chatbots may still be used to achieve it. Crabtree, Tolmie, and Knight (2017) find that privacy dissolves into a heterogeneous array of relationship management practices - meaning that for most people privacy is a matter of managing their relationships in and with the networked world. It could be possible for a chatbot to simulate the role of a friend, co-worker or someone else the player has a relationship to, and in that way help the player manage his relationships in the digital world and thus raising awareness.

The second most popular purpose of the chatbot serious games is education. Games with the main purpose of education, or knowledge transfer, is normally the most common type of serious game, with soft skills acquisition in second place (Ravyse et al. 2017). Chatbot games can be used to educate in the same way as most other game types, for example having a quiz as part of the gameplay.

Surprisingly, none of the chatbot serious games had the main purpose of raising awareness or promoting behavioral change in the player. This is normally the third most popular serious game learning outcome (Ravyse et al. 2017). However, in serious games it is possible to have primary and secondary learning outcomes in the same game. For instance, a game wishing to promote behavior change in physical activity may consider education on the positive sides of physical activity the most effective way to achieve the desired behavior change. Unless explicitly mentioned, the main purpose of the game may seem to be education, when in reality it is behavior change. This can also be the case when considering raising privacy awareness. Educating the player about how his information can be used and abused may serve to raise his privacy awareness. According to the privacy conceptualization ”privacy calculus” (see section 2.1.4), there is a trade-off when considering to share or not to share personal information. However, to be able to weigh the trade-off the person needs to be sufficiently educated on the possible ramifications of over-sharing information. Without knowing what a company can do with this information it is impossible to make an informed privacy decision.

Technology

The technologies used to implement the chatbots in the discussed games can be divided into two main categories: modern and old. Most of the games presented here are based on old technology. Often implemented in Artificial Intelligence Markup Language (AIML) to serve as a knowledge-base to support pattern-matching. To provide a rich and advanced dialogue in these games, the game developer needs a proficient knowledge and understanding of complex artificial intelligence concepts, and has a high development cost.

The only game that can be categorized as using modern technology is CiboPoliBot (Fadhil and Villafiorita 2017). As explained in section 2.6, advances in Natural Language Processing (NLP), machine learning and big data has contributed to making chatbots better and easier to develop (Lebeuf, Storey, and Zagalsky 2018). Major software companies are heavily invested in the development of chatbots, and Microsoft Bot Framework, which is at the foundation of CiboPoliBot, is cutting edge. To enhance player-chatbot dialogue, there exist several services which provide NLP based on machine learning, like DialogFlow (used in CiboPoliBot) and Microsoft LUIS. Fadhil and Villafiorita (2017) even go as far as to say ”To our best of knowledge, the proposed system is the first in which gamification and conversational interfaces are integrated to provide a meaningful game interaction.” As we have shown in this chapter, this is not true. However, as CiboPoliBot is the only chatbot serious game taking advantage of the technological advances in the last years, one can at least consider the statement to hold some truth.

Another important advantage in the modern chatbot technologies is the basic UI elements which complement the conversational interfaces. These are provided by the platform the chatbot is interacted with (such as Facebook Messenger, Telegram, Slack, Skype, etc.), and can be simple elements like buttons, lists, images, carousels, and menus. These simple UI elements make it possible to simplify the player-chatbot interaction when needed. For example, typing out every request and response can be far more tedious than clicking a button or selecting from a list, especially when there are only two or three reasonable options. Design best practices for Facebook Messenger developers state that: ”Decades of advancement in graphical user interfaces (GUIs) have shown how powerful it can be to directly manipulate objects in a UI: tapping an image to open it, pinching a map to zoom in, etc.”[9].

The lack of the possibility to incorporate basic UI elements may also be an explanation as to why so many of the games have improving communication skills of the player as the main purpose. When conversation is the only way to interact with the chatbot, it is also likely connected to the learning outcome. However, with the possibility to use buttons and other simple UI elements, the chatbot game can be used in almost any context. For instance teaching children about a healthy lifestyle (which is the case in CiboPoliBot), or privacy awareness in a smart city like in PrivaCity (presented in Chapter 4).

Table 3.1: Game elements used to engage the player in chatbot serious games.

Publication	Game elements to engage the player						
	Points	Role-playing	Leader-board	Emotions	Chatbot person-ality	Witty & funny	Conse-quential play
Fadhil and Villafiorita 2017	X		X		X	X	X
Othlinghaus and Hoppe 2017	X	X					
Jeuring et al. 2015	X	X		X			
Rosmalen et al. 2012							
Vaassen and Daelemans 2010				X			X
S. Barab et al. 2012		X				X	X
Neto et al. 2011	X		X		X		
Klüwer et al. 2010							
Bernsen et al. 2004				X	X		

Elements to Engage the Player

As explained in section 2.6.1, for the serious game to be successful in its desired learning outcome (education, behavior change, increased skill, etc.) it is vital to be able to engage the player in the game. People are motivated and engaged by different things, but there are several game elements or mechanics which can be used to further engage the player. In Table 3.1, the game elements used to engage the player in the chatbot serious games are identified.

Points is the most popular way to engage players in the game. This is an extrinsic motivation to the player, and is rewarded when he completes a task or answers correctly to a question. In i.e. CiboPoliBot (Fadhil and Villafiorita 2017) the player receives points when answering correctly on a quiz, and is used to decide the winner of the game. Accompanying points is often a **Leaderboard**. This is a way to engage the player in competition with other players of the game, encouraging the player to replay the game in order to achieve a high score (more points), and beat his friends or other internet strangers. Only 2 out of the 4 chatbot games using points as a reward employ a leaderboard as well. This is because in the remaining two games the points are used to evaluate the player in an after-action review, which is a way to increase the learning outcome.

The technology of chatbot may restrict the game from engaging the player with impressive graphics and spectacular sound, but it offers many advantages that other game types does not have. A chatbot serious game is an excellent way to convey **Emotions** to the player. In some games the emotions were reinforced by having a virtual person showing the facial emotions (Jeuring et al. 2015; Bernsen et al. 2004), whereas Vaassen and Daelemans (2010) only express the emotions textually. Humans are emotionally driven individuals, and seeing emotions as response to their actions is a great way to both engage and educate. Another advantage of the chatbot is to provide it with a **Personality**. Three

[9] *Design Best Practices: Conversation vs. GUI* (2018). `https://developers.facebook.com/docs/messenger-platform/introduction/general-best-practices`. (Visited on Mar. 1, 2018).

of the games use these personalities to engage the player. In Solis Curse (Neto et al. 2011), the chatbot narrator have been given a personality in order to establish empathy with the player. A chatbot with a personality may help the game become more immersive for the player, as he is accustomed to communicate with real people - not bland emotionless creatures. Further a game element to engage the player which suits the chatbot platform excellently is to use humor to engage the player with a **Witty & funny** chatbot. This is not something exclusive to chatbot serious games, and can be used as an element to engage the player in any kind of serious game if the designer wishes to. However, combined with the novelty of chatbot interaction it is an excellent way to engage the player. Two of the games discussed use humor to engage.

Role-playing is yet another way to engage players that is used by three of the chatbot games discussed. By letting the player assume the role of a certain person or profession, he may be further engaged in the game. In the article by S. Barab et al. (2012) the player assumes the role of a writer with the responsibility to save an entire village. This can be motivating to the player, and allows him to experience things he would never have in the real world.

Consequential Play is discussed at length in section 3.2.3. To see the consequences of one's actions is an interesting way to both engage the player and achieve learning outcome. In three of the discussed games, we consider consequential play to be an engaging game element. In the game by Vaassen and Daelemans (2010) the player is engaged by seeing the consequences of how better negotiation skills may improve the outcome and responses from the chatbot.

In addition to the identified game elements in existing chatbot serious game literature, the novelty of chatbot-interaction itself is a way to engage the player. Interacting in a new and exciting way can add entertainment value to the game, and keep the player's interest. However, this will likely not keep the player sufficiently engaged throughout the entire game. That is why adding more game elements, like the ones mentioned above, is a great way to further keep the player engaged and as a result hopefully achieve a better learning outcome.

Elements to Educate, Motivate or Raise Awareness

There are many ways to achieve the desired learning outcome for a serious game. The desired learning outcome may be education, behavior change, increased skill or other things, but there are several game elements which can be utilized by the game designer to enhance the learning outcome. As discussed in section 3.3.1, the dominant learning outcomes in the chatbot serious games discussed in this chapter are improved communication skills and education. Therefore, the game elements in those serious games are included by the game designers with that in mind. In Table 3.2, the game elements used to achieve the desired learning outcomes in the discussed games are identified.

Points is used in four of the discussed games. As explained above, rewarding points is used as a way to engage the player, but it is also an element used to educate. By receiving points for answers or decisions, the player will realize if it was correct or incorrect. Two of the games use **Quiz** as an element to educate the player. The player is scored according to his quiz-answers. This will encourage the player to be wanting to answer correctly, which in order to be able to he has to learn some kind of concept or information. Another reason

Table 3.2: Game elements used to educate, motivate or raise awareness in chatbot serious games.

Publication	Game elements to increase learning outcome						
	Quiz	Points	Simulate real setting	Provide information	Consequential play	After-action review	Emotional feedback
Fadhil and Villafiorita 2017	X	X		X	X		
Othlinghaus and Hoppe 2017		X	X			X	
Jeuring et al. 2015		X	X			X	X
Rosmalen et al. 2012			X	X		X	
Vaassen and Daelemans 2010			X		X		
S. Barab et al. 2012					X		
Neto et al. 2011	X	X		X			
Klüwer et al. 2010							
Bernsen et al. 2004				X			X

for scoring players is the possibility to use it in **After-action reviews**. Reflection on the game-session after playing the game is an excellent way to increase the learning outcome for the player (Ravyse et al. 2017). With a chatbot, reviewing the chat-log is a simple, yet effective way to impose learning on the player, and be shared with other players. In the game EMERGO by Rosmalen et al. (2012) the chatbot summarizes the conversation, and shows important topics not covered in that game session. Supplementing the game CuCoMag by Othlinghaus and Hoppe (2017) is a tool for supporting group reflection after the game session. This session is with an expert, and helps so that lessons learned by one player may be shared with the others.

To **Simulate a real setting** is a game element used by several of the chatbot games. These games are specified towards certain scenarios, and try to mimic them as closely as possible. The idea is that if the player becomes better at the game it will transfer to the same scenario in the real world. In the game by Vaassen and Daelemans (2010), professional negotiation is simulated with the chatbot as the counterpart, with the goal that this will increase the negotiation skills of the player in a real-world setting.

Provide information is a simple, yet effective way to educate the player. This game element is borrowed from traditional education, where the player is presented with information from the chatbot in an instructional way. Oftentimes this information has to be used in order to advance in the game, or be the topic of a quiz-question later in the game.

Emotional Feedback is a way to show the player how his actions affect the chatbot. As humans respond well to emotional feedback, it can be a powerful way to educate the player if he made correct or incorrect decisions, similar to how scoring points is used. **Consequential Play**, explained in section 3.2.3, is used in several of the chatbot serious games to enhance the learning outcome for the game by showing the player the consequences of his actions. The story of the game may differ based on the actions of the player and, in doing so, it is adapted to the playing style of the player.

Table 3.3: Game elements discussed or used to engage in adventure serious games.

Publication	Game elements to engage the player					
	Score	Hints	Collab-oration	Curiosity	Time-limit	–
D. M. Adams et al. 2012				X		
D'Apice et al. 2015	X	X				
Pilegard and Richard E. Mayer 2016						
Dickey 2011			X	X		
Hou and Li 2014		X			X	

3.3.2 Adventure Serious Games

Elements to Engage the Player

Providing the player with a **Score** is a popular way to engage the player in adventure serious games. By completing a task or progressing in the game, the player can i.e. see a bar fill up or a point score increase (D'Apice et al. 2015). A well-designed game ensures that the player is in their personal flow zones throughout the experience (J. Chen 2007). As some players are more skilled than others, it is important to facilitate for different skill levels. However, simply increasing the number of choices in the game is costly and may overwhelm the player, as having to make frequent choices can be annoying. Hou and Li (2014), whom discovered a correlation between flow and game acceptance, discusses the use of scaffolding, or **Hints**, to help the player through overly difficult parts, so that the player does not feel overwhelmed by the task. D'Apice et al. (2015) takes this one step further in the SIRET Security Game where the game automatically detects when the player is having difficulties with a task and provides hints of different quality to help the player progress. Using some sort of help to prevent the player from entering a state of anxiety (see Figure 2.5), but rather guide him through difficult parts, keeping him in a state of flow, can be key to both engage the user and boost learning outcome. **Collaboration** is widely regarded as a tool to engage and lead to deeper learning (Gokhale 1995). This can be done through being in the same room and discuss freely, or in an in-game chat. Dickey (2011) discuss the importance of **Curiosity** in the game to engage the player. This intrinsic motivation is important to motivate the player into continuing the game experience rather than abandoning it. A **Time-limit** can be a tool to challenge and motivate the player, but can also be a burden to some players. Allowing the player a sufficient amount of time to get familiar with game mechanics and reflect on their choices, is vital to prevent too stressful situations for the player.

Elements to Educate, Motivate or Raise Awareness

In the review of adventure games, multiple articles discuss the importance of creating a storyline that is closely connected to the real world settings and topic to be educated could occur. In other words, creating a WW2 game to raise awareness about global warming is not likely to maximize potential learning outcome, while instead locating the game in the

Table 3.4: Game elements discussed or used to educate, motivate or raise awareness of the player in adventure serious games.

Publication	Game elements to increase learning outcome					
	Relevant Narrative	Notes	Hints	Collaboration	End-Game Summary	Provide Information
D. M. Adams et al. 2012	X					X
D'Apice et al. 2015	X	X	X		X	X
Pilegard and Richard E. Mayer 2016		X				X
Hou and Li 2014			X			
Dickey 2011		X		X		
Morsi and Mull 2015					X	

arctic or on a flooded island would be a better option. **A narrative theme related to the learning outcome** can function as an important cognitive tool to organize material and hence boost the player's learning outcome (D. M. Adams et al. 2012). Another element that should be considered to help boost learning outcome is the availability of space to take **Notes** for the player. Pilegard and Richard E. Mayer (2016) provide a paper worksheet for the participants, resulting in increased learning outcome without impeding reported engagement. D'Apice et al. (2015) use a different strategy by including a journal in the game where the player can write down his notes. Taking notes, being a widely used tactic for better learning in traditional school settings, should absolutely be considered as an element in a serious game in one form or another. As discussed under engagement, the use of **Hints** can also be used to help the player obtain the intended learning outcome. This scaffolding can help ensure that the player progresses through the game and does not get stuck in sections, skips it or abandons the game entirely. Throughout the game **Providing Information**, much like more traditional learning methods, is a simple way of presenting the material to the player. This can be done in several different ways, like a text box or having it said by an NPC (D'Apice et al. 2015). An **End-Game Summary** is an element that could be used in order to let the player get a second time to reflect on the learned material in the adventure genre.

Chapter 4

PrivaCity Game Design

This chapter will present the design of the game **PrivaCity**. The game description, with target audience, storyline and main learning goal is presented, along with a description of the levels of the game. All design decisions are made as a result of the Privacy Game Co-Design Workshop results (see Appendix A and section 2.5) with the target audience as participants, and findings made in the literature review in Chapter 3. To answer **RQ1.2** and **RQ1.3**, the learning elements and engagement elements are presented throughout the game. These game elements are designed according to the findings presented in the related work.

4.1 Game Description

This section will present the target audience, storyline and main goal of the game.

The game is a chatbot serious game on the platform Facebook Messenger and in the web-browser. The progression of the game is mainly conversationally driven, but includes some UI elements to guide the player, such as buttons and lists. The simple UI elements are often used to help the player in the right direction when he seems stuck or lost. The game can be played with both mobile device through Facebook's Messenger app[1], as well as in a web-browser on Facebook Messenger[2]. The game requires the player to have a persistent internet-connection, as that is needed to send messages and receive responses from the chatbot game. Intended time used to complete the game is 20-45 minutes. A short video demonstrating the main concepts of PrivaCity can be found at `https://youtu.be/fio3eYKd8_8`.

Some changes have been made to the game for the main evaluation. These are discussed in section 7.1.

[1] *Facebook Messenger for iOS* (2018). `https://itunes.apple.com/us/app/messenger/id454638411?mt=8`. (Visited on Mar. 7, 2018); *Facebook Messenger for Android* (2018). `https://play.google.com/store/apps/details?id=com.facebook.orca`. (Visited on Mar. 7, 2018).

[2] *Facebook Messenger* (2018). `https://www.messenger.com/`. (Visited on Mar. 7, 2018).

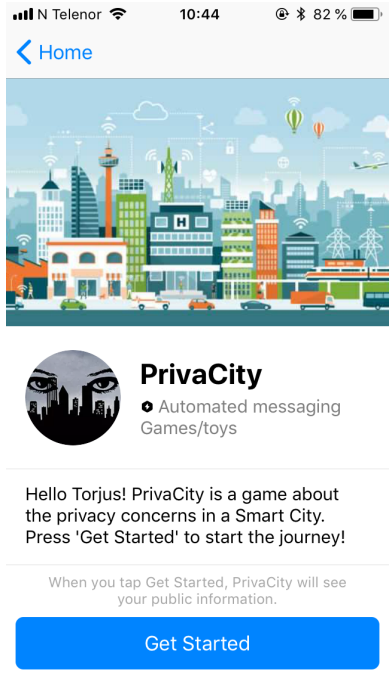

Figure 4.1: Screen showing how to initiate the conversation with the chatbot on a mobile device.

4.1.1 Target Audience

The target audience of the game is teenagers. As explained in Chapter 2, people in general aren't aware of the collection and usage of personal data. Individuals rarely have a clear knowledge of what information organizations and other people store about them or how that information is used. Teenagers of Norway associate a lower perception of risk in online activities than the general population, as well as thinking they are able to decide what is safe and not better than most people (NorSIS 2017). In other words - young people overestimate their ability to determine safe internet behaviour. At the moment, nobody holds the responsibility of making children and teenagers becoming responsible digital citizens with good knowledge regarding privacy concerns. This is the main reason why teenagers are the target audience of the game.

The story and mechanics of the game are in English, and require some proficiency in the English language from the player. Therefore the most suitable target group is High School (VGS) students, age 15-19. However, most teenagers of today already play games in English (NorSIS 2017), and therefore we assume the language won't be a problem.

4.1.2 Story Line and Scenario

The results from the co-design workshop ran with teenagers show that the problem domains most relevant to them are privacy in social media and in smart cities. In the special-

ization project (Berger and Sæthre 2017), we showed that privacy on social media is a topic that already receives a lot of attention - by serious games aiming to raise awareness (Cetto et al. 2014; Vanderhoven et al. 2015), and internet resources such as the government-funded learning-initiative Dubestemmer.no[3]. Therefore, the main problem domain for the serious game PrivaCity is privacy in smart cities. Why this is a privacy scenario which requires attention is explained in section 2.4.2.

The game is an adventure game where the player advances the story by completing levels. Each level is related to raising the privacy awareness of the player by using learning elements, as well as engaging the player with engagement elements. To advance, the player has to complete a puzzle or challenge. The story of the game follows a narrative, but the player chooses how he wants to play the game and some decisions have consequences for the rest of the story in the game.

The main story of the game PrivaCity is that the fictional city ”Metropolis” has been a smart city for a few years. The city council has been using IoT sensors to collect a lot of information throughout the city, and has been using it to improve the efficiency, environment, safety, and economy of the city. However, as we begin the story of the game a new party has taken control of the city council. This political party is called ”Electoral Norwegian Democracy Privacy” party, or ”E.N.D. Privacy” for short. As the name might suggest, the party is looking to abuse the information collected in the smart city grid for their own advantage, not respecting the privacy of Metropolis’ citizens.

The final goal of the game is to destroy the server with all this data used for violating the privacy of the citizens. The player progresses through the game by solving tasks of varying difficulties. Along the way, he can choose one of two paths, where both will eventually lead to the end of the game. There he will be presented with an end game summary where he can reflect on decisions made and what he has learned. More detailed description of each level can be found later in this chapter (section 4.2).

4.1.3 Learning Goals

The main goal of the game is to raise the privacy awareness of the player. Because it is impossible to focus on all aspects of privacy, the scenario of the game is privacy in smart cities. To achieve this raised privacy awareness, the player is educated on what a smart city is, some of its advantages, as well as privacy concerns in a smart city (explained in section 2.4.2).

The game also aims to make the player more aware of the privacy decisions we constantly make in a digital world. The privacy conceptualization ”privacy calculus” (see section 2.1.4) is based on trade-offs when considering to share or not to share personal information. First of all, the player needs to be aware that he does, in fact, have a choice and can choose not to share information. Furthermore, to be able to weigh the trade-offs, the person needs to be sufficiently educated on how personal information can be used and abused.

The privacy trade-off decisions are rarely clear-cut. It is a personal decision, and it is impossible for game designers to decide if a decision is ”correct” or ”incorrect”. The game tries to make this clear to the player - that a decision is not black and white, but comes with

[3] *Dubestemmer.no* (2018). `http://www.dubestemmer.no/`. (Visited on Feb. 12, 2018).

both advantages and disadvantages. To achieve this, each of the game levels has distinct learning goals for the player.

In Table 4.1, the primary and secondary learning goals for each level are presented. The general idea is that at the beginning of the game the player will be presented with the positive sides of a smart city. As the game progresses, more and more privacy issues and concerns show up, and the player begins to see the bigger picture. After having seen both positive and negative sides of a smart city, the player puts his knowledge to use in quizzes, interviews, and classifications. Towards the end of the game, the learning goal is to make the player understand that privacy is a trade-off and can be very subjective. The entire game the goal has been to destroy the data collected in the smart city. However, when the player arrives in the server room he actually gets to make the decision on whether to destroy it or not.

Table 4.1: Primary and secondary learning goals for each level of the game.

Level	**Primary learning goal**	**Secondary learning goal**
0	What is a Smart City (SC)?	Smart City advantages.
1	Privacy issues in SC.	Privacy is a trade-off.
2	Privacy in general, focus on SNS	What to share or not to share.
3	Data collected for one purpose can later be abused for another purpose.	Facebook & the Cambridge Analytica scandal.
4.1	Specific examples of how info can be abused in a SC.	How the data can be used in a positive (non-intrusive) way.
4.2	*None (Mainly a fun challenge)*	The privacy conceptualization calculus (trade-offs)
5.1	Put knowledge of data in SC to use.	See things from ”bad guy” perspective.
5.2	IoT risks from a real world scenario.	What information the player consider too personal.
6	Privacy decisions is not black or white.	You actually have a choice to share or not to share

4.1.4 Game Elements

Learning Elements

To achieve the mentioned learning goals, several learning game elements have been identified. These are designed according to the findings presented in the related work (see Chapter 3). In Table 4.2 the mapping between learning elements and levels of the game PrivaCity is presented. Some of the learning elements are consistently present in most levels of the game, such as ”Provide Information”. Others are only present in some of the levels, such as using a ”Real Life Scenario” in the level. By having this clear distinction, hopefully it will be possible to identify which game elements are effective to raise privacy awareness with a chatbot serious game.

Table 4.2: Learning game elements used in each level of the game

Level	**Provide Info**	**Conseq-uential Play**	**Repeti-tion**	**Quiz**	**Emotions**	**Points**	**Attacker POV**	**Real Sce-nario**	**After-Action report**
0	X								
1	X	X							
2	X		X	X	X	X			
3	X	X						X	
4.1	X			X		X		X	
4.2	X		X						
5.1			X	X			X		
5.2	X			X		X	X	X	
6	X	X	X						
Sum			X						X

Engagement Elements

As explained, the primary goal of a serious game is not to entertain, but to educate, motivate or promote behavioral change. However, it is still very important to engage the player in the serious game. For the game to be successful in its "serious" aspect, studies show that first the player needs to have fun (Ravyse et al. 2017). Thus, one of the main success factors for a serious game is to not disrupt this hunger for fun, but rather quietly use it to engage the player in the learning material.

As with learning elements, engagement elements have been identified for each game level and is presented in Table 4.3. The novelty of interacting with a chatbot is an engagement element that is persistent throughout the game, though likely most effective in the earlier levels of the game and more effective if the player has little experience with chatbots.

One of the main drivers of the game is curiosity. The game expects the player to be curious to explore the possibilities of the level he is in. As explained in section 2.6, what engages the player depends on what kind of user he is - some players are more motivated by social competition or collaboration with other players (Tondello et al. 2016). Curiosity is a typical intrinsic motivation. Intrinsic motivation involves engaging in a behavior because it is personally rewarding; essentially, performing an activity for its own sake rather than the desire for some external reward (Cherry 2018). Not all players are motivated by intrinsic values. For those players, the game PrivaCity uses rewards and points for answering quiz questions correctly - a typical extrinsic motivation.

By having classified these engagement game elements for each level, it will hopefully be possible to identify which work well in a chatbot serious game.

The concept of flow is that there is an ideal balance between how challenging a task is and the ability of the player (see Figure 2.5). In games and serious games, the challenge of the task should be proportional to the abilities of the player. PrivaCity tries to follow this concept. In the early levels of the game, when the ability of the player is low, the difficulty to complete the level is low. The player also receives more hints. However, as the game progresses the difficulty of each level is increased. This will hopefully result in a game

that keeps players in the right balance throughout their experience and in the zone of flow.

Table 4.3: Engagement game elements used in each level of the game.

Level	**Chatbot novelty**	**Curiosity**	**Reward**	**Points**	**Consequential Play**	**Funny**	**Role-play**	**Character**
0	X	X						
1	X	X	X		X			
2	X	X	X	X		X		X
3	X	X			X	X		X
4.1		X		X		X		
4.2		X						
5.1						X	X	X
5.2				X		X	X	X
6					X			

A final way to engage the player, not described in Table 4.3, is the use of ”emojis” throughout the game. Emojis are used in PrivaCity for multiple purposes: break up long and boring text, clarify which objects can be interacted with, express emotions, and clarify if a ”character” is talking to the player. As explained by Willoughby and Liu (2018), emojis are used extensively by teenagers when interacting with each other, and can be used to ”help tell a story”. However, a possible issue is the reduced perception of credibility in the message when using emojis, as messages without emojis are perceived as more credible (Willoughby and Liu 2018). Nonetheless, in PrivaCity emojis are used for multiple purposes, which hopefully won't reduce the credibility of the learning outcome.

4.2 Game Levels

This section will describe the different levels of the game, including learning goal, learning elements, and engagement elements.

4.2.1 Level Architecture

The game is divided into 7 levels, and the player can choose different paths through the game. The game starts at level 0 and if completed, ends at level 6, regardless of chosen path. Figure 4.2 shows the different paths the player can move through the game. Some levels are a mandatory visit in order to finish the game, while others can be skipped. In Level 3 the player is asked to make a choice of path, and will either follow the Infiltration path or the Sneaky path.

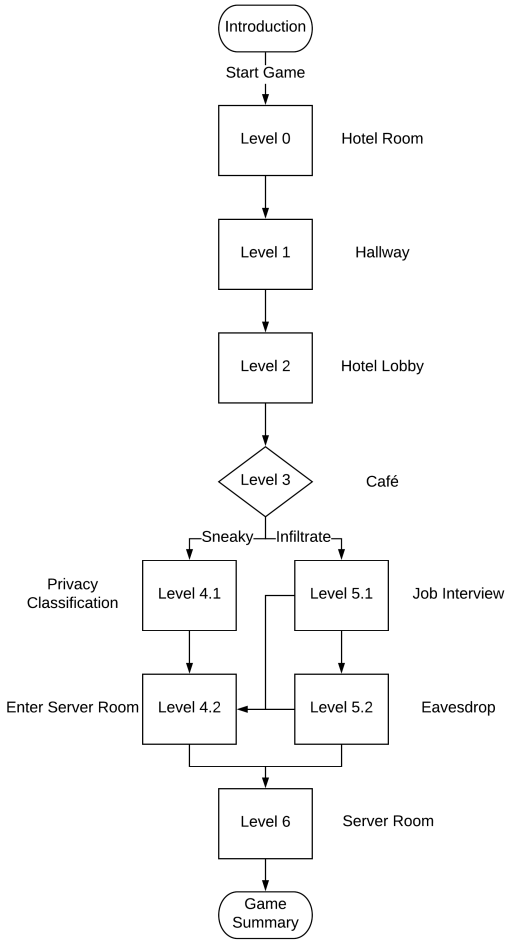

Figure 4.2: Graph showing the possible paths through the levels the player can move.

4.2.2 Level 0: Hotel Room

Task Description

In the first level upon starting the game the player is placed in a hotel room. The bot presents that there are several items located in the room: a glass of water, a newspaper, and a door. The door is locked and must be opened using a key hidden under the newspaper. The player can interact with all the items presented by the bot, and by picking up the newspaper a picture of newspaper headlines presenting the main concepts of a smart city as well as societal benefits of the technology. After putting away the newspaper, the player is informed that a key was hidden under the newspaper. The player must then use the key to open the door.

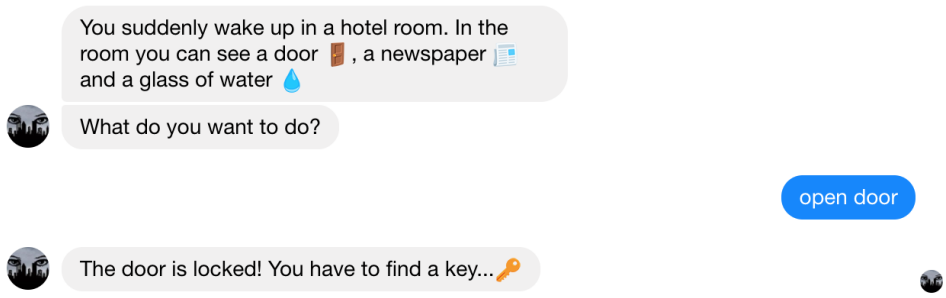

Figure 4.3: How the player is presented to first level and can interact with the game.

Learning Goal

The main learning goal of the first level is to give a basic introduction to the topic of smart cities. Basic concepts include how a smart city works, as well as how data is gathered and used. Additionally, the player should learn how the smart city can benefit society with improved efficiency, environment, safety and economy. Besides learning goals that are related to the privacy scenario, the first level also plays an important role in letting the player familiarize with game mechanics, learning how to control the player and interact with objects using the chat only.

Learning Elements

To ensure the players learn the basic concepts of Smart Cities the game use the element of **providing information** through the newspaper - a creative twist to a traditional, yet effective, way to educate the player. After having read the newspaper, the player can open it again anytime by scrolling through the chat, or viewing attached items sent from the bot for repeated learning.

Engagement Elements

The main driver of the user's engagement in this level is **curiosity**. The player is free to explore the room by writing any command in the chat. Another important design choice of the first level was to make the first task simple. According to the concept of flow, the player, whose skill level so far in this game is low, should not be exposed to challenges that exceed his skill level in order to achieve a state of flow. If the player is struggling, the bot can provide subtle hints such as: "Have you read the newspaper today?". Another element to engage the player is the **novelty** of interacting with a chatbot. As this is the first level where the player gets to explore how to advance the game in a chat, he can familiarize himself with the controls and be entertained.

4.2.3 Level 1: Hallway

Task Description

After leaving the room, the player is placed in a hallway, containing several locked doors, an elevator, and an ice cube machine. Before entering the hallway, the player receives a text message from a friend in the city council, warning him of the new government. The message tells the player to be careful about sharing too much private information, and the first indication that something is wrong. The elevator is the way to proceed the game, but is locked with a password which is the player's name. To help the player, he receives a hint when trying to call for the elevator, which is his own name shuffled letter for letter (Eric Hansen = cEir nseaHn). Before exiting the hallway, the player receives a notification asking if he would like to share his location with Snapchat for the rest of the day and earn 50kr.

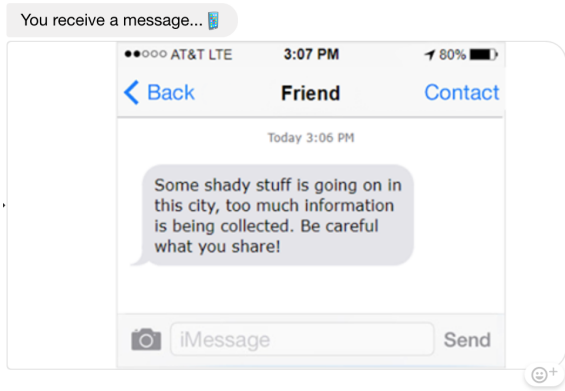

Figure 4.4: Before leaving the room, the player receives a message from his friend.

Learning Goal

In this level, the intended learning goal is to make the player aware of possible problems with smart cities. A secondary learning goal is to teach the player that privacy is often a trade-off, and that you sometimes pay with your personal information to receive a reward - such as 50kr for sharing your location for the rest of the day.

Learning Elements

Once again the game will **provide information** as a way to educate the player. In this level the player will also be asked to perform an action in regards to a privacy trade-off, choosing whether or not he would like to share his location. This is the first time the player is introduced to **consequential play**. Whether he chooses to share or not to share the location, will have consequences for the story in the game. The game also involves the player personally as the password for the elevator is the name of the player, giving him the feeling of being surveilled.

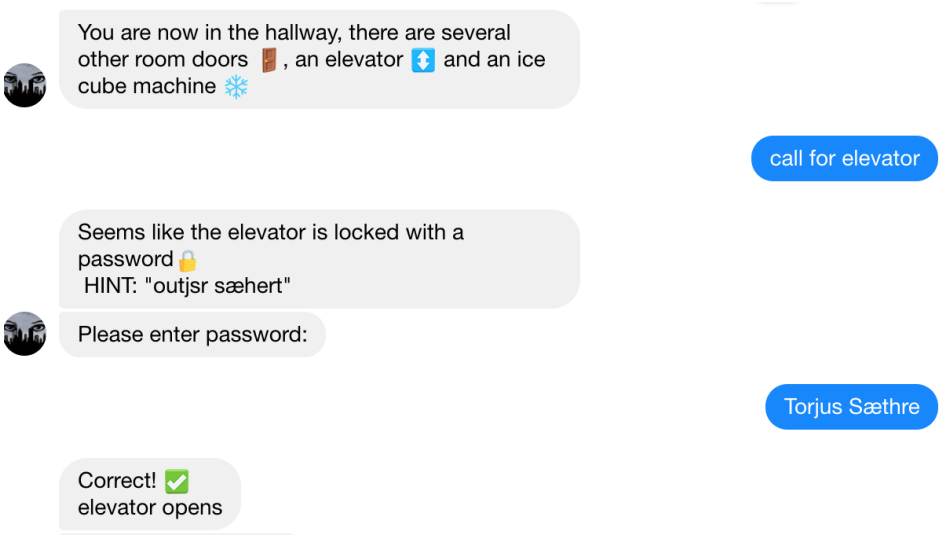

Figure 4.5: To take the elevator the player needs to provide a password. The password is his full name (collected from Facebook).

Engagement Elements

In Level 1, the **difficulty** is increased in order to challenge the player appropriately, and ensure he does not get bored. If the player is having problems. The player can explore the hallway, which has objects that can be interacted with in several ways. This can be engaging to the **curious** player. The players that are more engaged by receiving **rewards** can choose to share the location with snapchat in hopes that the money will provide an advantage for later in the game. As explained in the learning elements, this is the first introduction to **consequential play** for the player, which can act engaging.

4.2.4 Level 2: Hotel Lobby

Task Description

As the player exits the elevator he finds himself in a hotel lobby. He can see a receptionist, a ”quiz-o-mat”, and a person sitting with a laptop. The first thing that happens is that the player receives a message from the same friend telling him to take a taxi to Café del Mar immediately. The receptionist can order a taxi for the player, but for that he needs money. Conveniently enough, the quiz-o-mat gives you money to answer quiz-questions about privacy correctly. The person on the laptop is a blogger telling the story of how her naked pictures got leaked on the internet.

Learning Goal

The learning goal of the level is to learn more about smart cities and privacy in general. The quiz is about general privacy concepts, but also focused on specific privacy issues in

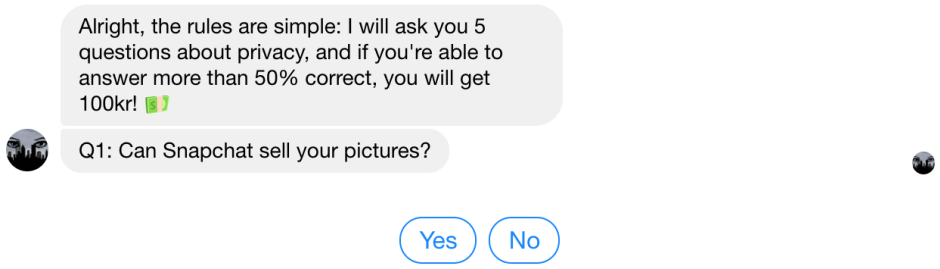

Figure 4.6: Example question from the quiz.

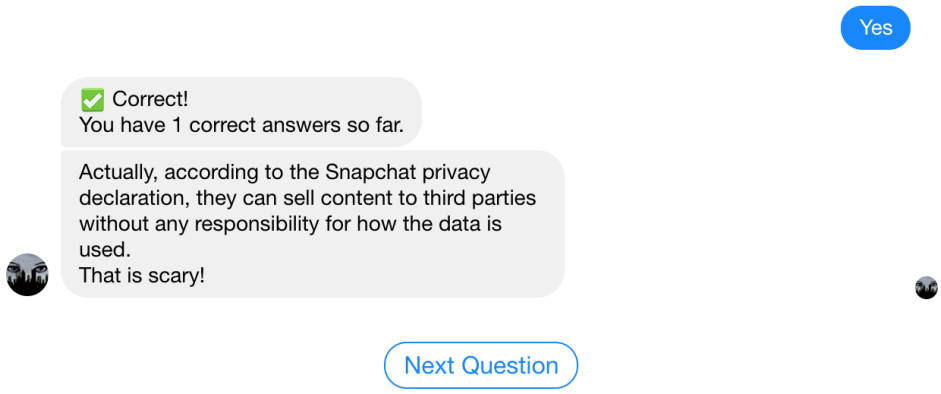

Figure 4.7: After answering a questions, the player gets feedback on correctness and explanation of the answer.

smart cities. This way, the player can use some of the information he has learned so far. The full list of quiz questions and answers can be seen in Appendix D.1. Another learning topic of this level is what to explicitly share or not to share. This is taught through the emotional story from the blogger.

Learning Elements

The main learning element in the level is the **quiz**. The questions are a combination of **repetition of previous knowledge** from the game, as well as new topics. Repeating knowledge several times is a well-known tactic to increase the learning outcome of any activity (Richard E Mayer 1983). After each question, the quiz-o-mat gives an **explanation of the correct answer**. In the specialization project (Berger and Sæthre 2017) we prototyped a Kahoot![4] as a serious game to teach privacy awareness. The initial findings were very positive, and through interviews it became apparent that one of the main contributing factors to the success was that the answer was explained after each question. Answering correctly

[4] *Kahoot! - What is Kahoot!?* (2017). `https://kahoot.com/what-is-kahoot/`. (Visited on Nov. 2, 2017).

rewards the player (with money), and to progress the game he has to answer enough questions correctly. The player can take the quiz as many times as he would like, to increase the learning outcome.

A secondary learning element in this level is the **providing of information** from the blogger. As in some of the games explored in the related work (Chapter 3), the goal is also to play on the **emotions** of the player. By seeing how over-sharing of information has affected the blogger, the player will have a raised awareness of what not to share himself. Some of the quiz-questions are related to what the blogger has provided information about, so that the player can put the information to use already there.

Engagement Elements

The main engagement element in this level is the motivation to get money (**reward**) to be able to progress the game to the next level. This is done by answering the quiz correctly, motivating the player to learn the topics and questions in it. As the player now has learned more about privacy and smart cities, the difficulty of the quiz is proportionately more difficult. This is in line with the theory of flow. In the hotel lobby, there are several other ”people” that the player can interact with. These people are **characters** that the player can relate with. To further entertain the player, some of the characters have **funny** or witty replies, which may surprise the player.

4.2.5 Level 3: The Café

Task Description

Upon arriving at the café, the player gets into a conversation with his friend who works at the city council as a security guard. The friend explains how the new party in power, E.N.D. Privacy, is planning to abuse the information collected over the last few years in the smart city grid for their own advantage, not respecting the privacy of Metropolis' citizens. However, as he works in the city council, he has a plan for how to stop them. He knows where the information is stored, and that there are two ways to destroy the data servers. The plans are: (1) Sneak into the server-room where the data is stored without being detected by the smart city sensors, or (2) Infiltrate the new government and win their trust. The player can choose which plan to execute, depending on if he is feeling good at being sneaky or at infiltration. If the player chose to share his location in level 1 (The hallway), the friend informs him that ”they” already know that he's here.

If the player chooses sneaky, the task of this level is to find the password for the back door to the city council headquarters. If he chooses infiltration, the goal is to find the telephone number to a recruiter in the city council. This is hidden in the bottom of the coffee cup given to the player from his friend. The friend explains that he has already given the player the password/phone number, and that he can't say it aloud since there are ”eyes everywhere”.

After the conversation, the player can explore the café. There is a barista, another couple sitting at the next table, your coffee cup, and a light switch. The barista can sell coffee, but the player doesn't have any money since he spent it all on the taxi. The other couple is discussing the Facebook and Cambridge Analytica scandal (explained in Chapter

2) and doesn't want to be bothered. The light switch can be turned off, but then the barista gets annoyed and turns it on again. The coffee must be drunk in order to progress to the next level, which is 4.1 or 5.1 depending on his choice of plan.

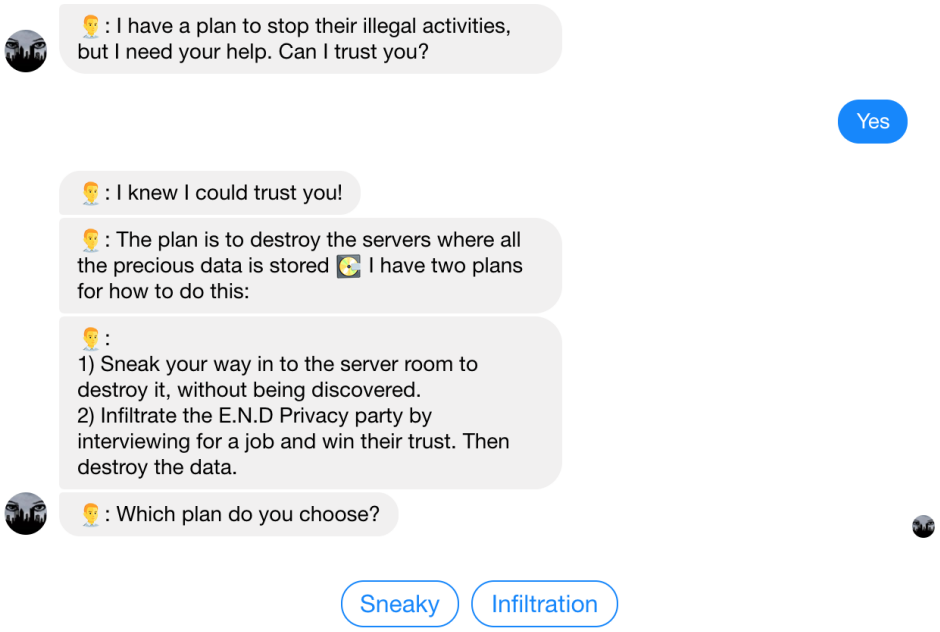

Figure 4.8: In the café the player meets his friend. He can choose between two plans presented by the friend.

Learning Goal

The learning goal of this level is to learn more about how information in a smart city can be abused by the people with access to the information. Additionally, that information collected for one purpose can later be (ab)used for another purpose. The player can also learn about the Facebook and Cambridge Analytica scandal by listening to the conversation on the other table.

Learning Elements

A learning element is the **information provided** by the friend and men at the other table. The concept of privacy trade-off is taught through **consequential play** - if the player shared his location earlier. The men at the other table are providing a **real scenario** as they are discussing the Facebook-Cambridge Analytica scandal if interacted with.

Engagement Elements

The main engagement element in this level is **consequential play**. It is used in several ways to engage the player. He makes a decision on which plan to execute, making a decision for how the story progresses. If the player hasn't turned off the lights (yet), the barista treats him politely. If the light switch has been flicked, the barista is annoyed with the player. And if the player shared his location earlier, he is now presented with the consequences that the city council already knows that he is at the café. Having consequences of actions was one of the main engagement and learning elements which were a recurring theme in the workshop results, as explained in section 2.5. To see the impact of your actions on the world is a powerful way to both learn and engage in games, as explained by "Transformational Play", and has been tested in several adventure games (see section 3.2.3). As in level 2, the player can use **curiosity** to explore the café, where there are several **characters** which are designed to be **funny** to the player.

4.2.6 Level 4.1: Privacy Classification

Task Description

After successfully entering the code to the back door, the player on the sneaky path enters a small room. The only things he can see are a file cabinet with drawers and a wardrobe closet. To find a paper hidden in the closet, the player must first locate the flashlight located in the bottom drawer. The top drawer only contains a pencil (which isn't used for anything). The sheet contains examples of how the council is looking to use or misuse the smart city data. The player's task is to classify these actions as either privacy violations or not. After completing the task, the player stumbles upon a secret door in the closet.

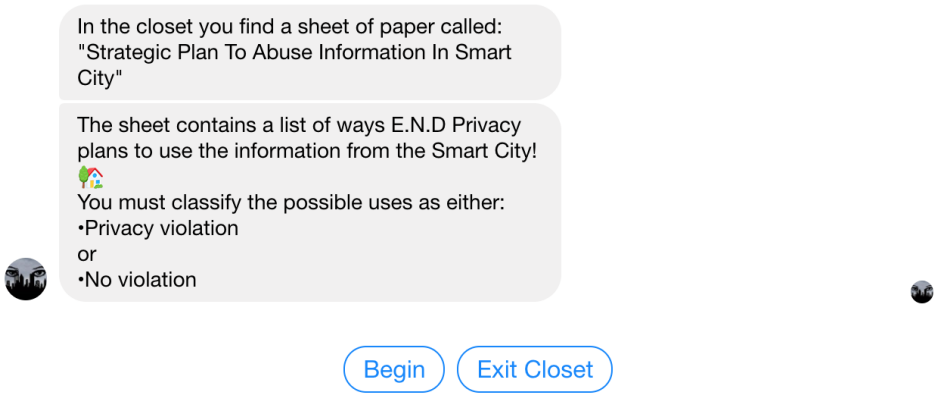

Figure 4.9: The player is asked to classify statements as *Privacy violation* or *No violation*.

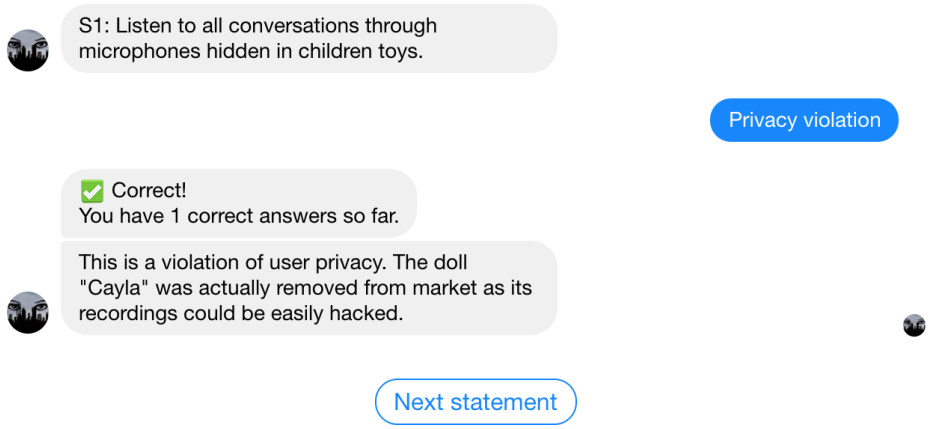

Figure 4.10: After a classification, the player gets feedback on correctness and explanation of the answer.

Learning Goal

The learning goal of the first sneaky task is to learn about the dangerous misuse of smart city personal data, as well as being made aware of how it can be used in a positive manner. The player has to reflect on what kind of personal data he is comfortable with sharing and being studied by a potential third party. The explanations contain real-life examples and scenarios of how information can be abused in a smart city. The full list of privacy classifications can be found in Appendix D.2.

Learning Elements

The task is in a **quiz** like fashion. The player evaluates if the statement, in their opinion, is considered a privacy violation. This decision is subjective, but the answer is still either rated as correct or incorrect. To enhance the learning outcome, a brief comment or explanation is provided after each of the questions, as discussed in section 4.2.4. Thomas W. Malone (1980) discusses this constructive feedback as a way to boost educational outcome as it does not only reveal the gaps of the player's knowledge, but helps them see how they can enhance and improve their knowledge. The explanations are collected from real-life examples or scenarios in smart cities. Throughout the classification, the player receives **points** for answering correctly.

Engagement Elements

The player enters a small room intended to trigger the player's **curiosity** and become eager to search for clues. Earlier in the game, the player was asked to remember knowledge from the newspaper in order to complete the ensuing quiz. The player might remember this and feel engaged to classify the privacy in order to complete the game. The chatbot will also provide hints if the player is struggling, as well as respond with **witty** comments to player

actions. Receiving **points** for classifying statements correctly can be engaging, and the **difficulty** is higher than before.

4.2.7 Level 4.2: Enter Server Room

Task Description

The main task of the level is to break into the server room. The server room is locked with a code word. The word can be obtained by locating a sheet of paper and a second paper with holes hidden inside a picture frame. To reveal the code, the player must put the holed paper on top of the other to reveal it. In the room, there is a table with the sheet of paper and two more decoy items. A whiteboard with multiple equations is also present, and the task for the player is to use the sponge to clear the whiteboard leaving only the letters written in permanent. The remaining letters tell the player to look inside the frame of a painting on the wall, containing the holed paper.

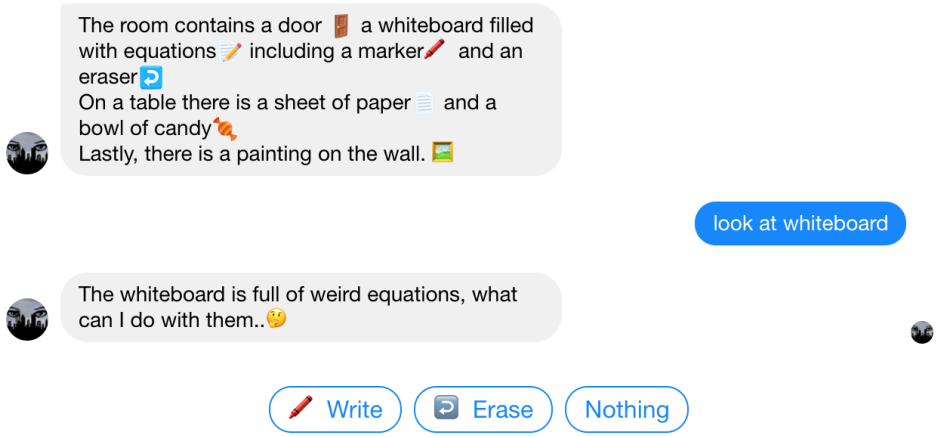

Figure 4.11: In level 4.2 there are many objects to interact with.

Learning Goal

This level focuses more on the gaming and fun element after completing levels highly focused on educational purposes. Despite this, there is provided information about smart cities in the text. The text is about the concept of ”privacy calculus”, and contains both new information, as well as the knowledge that the player has already been introduced to.

Learning Elements

Through the paper on the table, the player can read a rather long text which **provides information** about privacy, discussing important privacy-related concepts. The text itself is not related to solving the task, and reading it is not required. However, the player is likely

to read through it as the game previously has required the player to do so. **Repetition** of the knowledge is used to increase the learning outcome

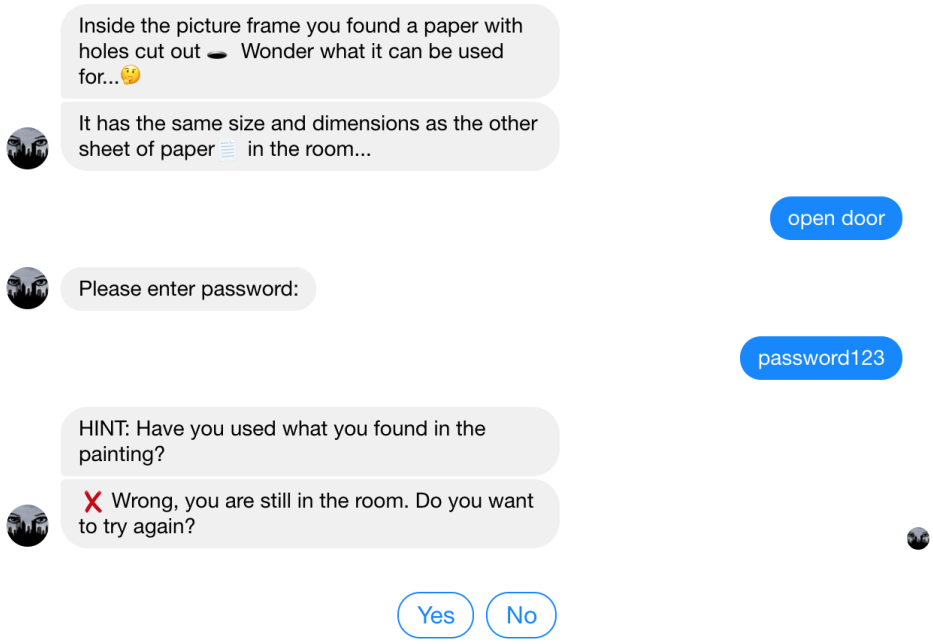

Figure 4.12: Example of a hint the player receives when answering the password incorrectly too many times. The hint is customized to which clues the player has gathered

Engagement Elements

This level will see an **increase in difficulty** compared to previous levels. As the game is closing in on the final levels, it is reasonable to assume that the player has an increased skill level in the game, and the game must therefore increase the challenge accordingly. This is important to assure that the player is engaged in his Flow state as discussed by J. Chen (2007). The main engagement element to make the level fun is **curiosity**. The whiteboard and holed sheet of paper are two tasks of a similar type where an action is required to reveal a code word hidden in plain text. The first task with the whiteboard might work as a way of foreshadowing, making it easier for the player to understand what to do with the two sheets of paper. To help the player progress, a time constraint will be set on the time to study the sheet of paper as well as the whiteboard. The time constraint will be enforced by a friendly reminder from the chatbot, telling the player that he should probably look elsewhere.

4.2.8 Level 5.1: Job Interview

Task Description

This level is a job-interview for the position as ”data usage expert”. The player attempting to infiltrate the Privacy party is in a dialogue with a recruiter, and must convince him that he is an expert at how personal information can be used. The interview questions are related to specific scenarios of how the E.N.D. Privacy party could use the information about its citizens, both for good and evil. To get the job, the player must know enough about how information can be abused, and be able to convince the recruiter. If he gets the job, he progresses to level 5.2. If he isn't able to convince the interviewer, he must resort to being ”sneaky” and goes to level 4.2 - breaking into the server room since he is already in the building (see Figure 4.2).

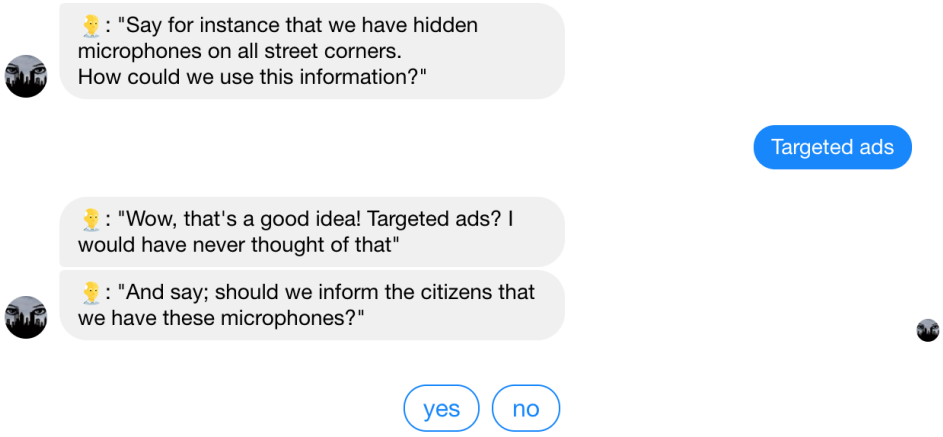

Figure 4.13: The player does a job interview for the position as ”data usage expert”.

Learning Goal

The learning goal of this level is to use what the player already knows about privacy in smart cities. However, this time the perspective is from the ”other side”. Until now, the player has been focusing on identifying privacy issues in smart cities. Now he has to see things from an attacker perspective, and imagine ways that personal information from a smart city can be used.

This learning goal is a part of the main learning goal of the game to make the player more aware of the privacy trade-offs in the privacy calculus. It is easier to weigh the positives and negatives when you know how the information can be used against you (i.e. the negative) and the value of the information.

Learning Elements

To see things from the **attacker point of view** is a learning element that was a recurring theme in the results of the user study workshop (see section 2.5). In doing so, the player

will be able to see the actual value of personal information.

The interview dialogue takes the form as a sort of **quiz**, where the recruiter asks questions and the player has to answer them correctly. In addition, between the questions, the recruiter provides information on what kind of information they already have stored on the citizens, and the player's job is to figure out how to use it. Before starting the interview, the player gets the choice to review what he has already learned from the conversation with his friend and the newspaper from level 0. This provides **repeated learning**.

Engagement Elements

To engage the player, the interview recruiter will have a personality (**character**). In the chatbot, serious games inspected in the related work (section 3.2.1), giving the chatbot a personality was a game element used by several games to engage the player. In this level, the recruiter will have a friendly personality. However, if the player answers the questions in a weird or unexpected fashion, the personality of the recruiter will become more and more suspicious. Another game element used in several chatbot serious games to engage is that of **role-playing**. In this level, the player role-plays as a "data usage expert", which can be a motivating way to see things from another perspective.

4.2.9 Level 5.2: Eavesdrop

Task Description

In this level, the player has passed the interview and has now gained the trust of E.N.D. Privacy. He is asked to classify audio recordings from a popular interactive children toy which includes a microphone that the city council has access to. The player must evaluate the recordings and classify them as being **critical to the state**, possibly used for **blackmail**, or **not interesting**. This task is related to a real-world scenario where the interactive doll "Carly" was discovered to have major security flaws, and that the creators recorded all user voice commands[5]. Depending on the performance of the player, he will either get the job, granting him access to the server room or told that he is not suited for the job and directed to level 4.2.

Learning Goal

The learning goal in level 5.2 is that the player can see the possible risks of IoT. By gaining access to a lot of personal information of the citizens through the audio recordings, the player will get a sense of what information is too personal to be shared online. The audio recordings are available through the doll "Carly" which is a real-life example of an IoT device with insufficient security. The full list of audio recordings is available in Appendix D.3.

[5] *Call for privacy probes over Cayla doll and i-Que toys* (2018). `http://www.bbc.com/news/technology-38222472`. (Visited on Mar. 7, 2018).

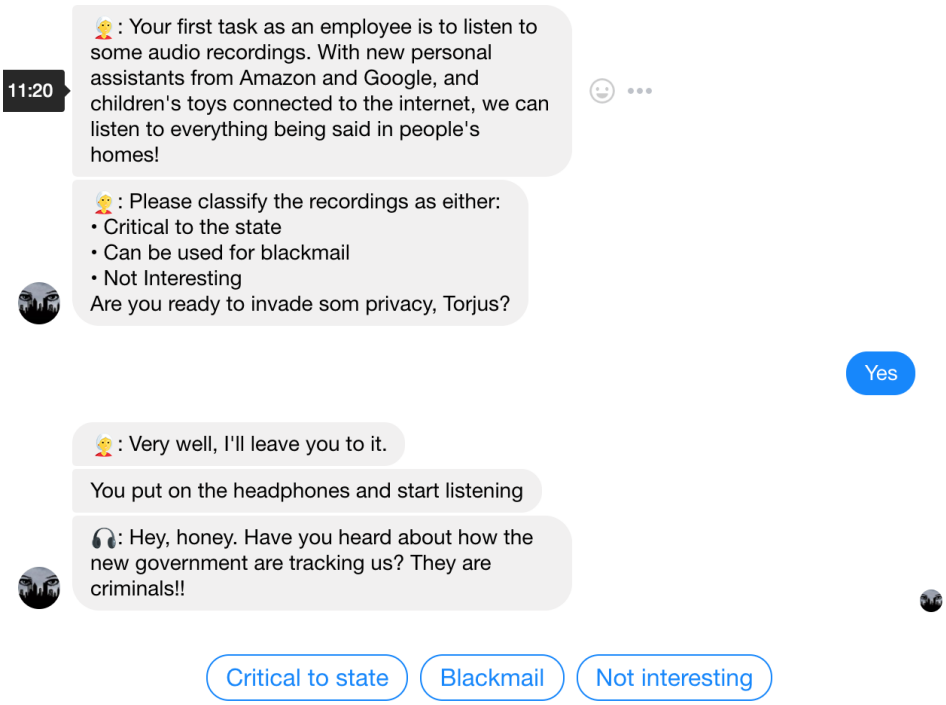

Figure 4.14: After passing the interview the player is set to listen to recordings and classify them for E.N.D. Privacy.

Learning Elements

In this level, the player once again gets to see things from an **attacker point of view** by gaining access to a lot of personal information. The level can be considered a kind of **quiz** where the player has to classify the recordings correctly. For each recording that is classified correctly, the player receives feedback if it is correct and receives a **point** to increase his score. After each question, an explanation is provided. A lot of the recordings are related to **real world examples**, making them feel more ”real” for the player.

Engagement Elements

The player is engaged by playing out a **role-play** as a bad guy, since he has now gained the trust of E.N.D. Privacy. During the quiz, he is incentivized by keeping score and getting **points** for classifying audio recordings correctly. Some of the recordings and explanations are designed to be **funny** to the player - for instance that citizens getting STDs from cheating can later be blackmailed.

4.2.10 Level 6: Server Room

Task Description

The player finally enters the server room, which is completely dark. The first task is to turn on the lights. When the lights are turned on, the player is told that he is now in the server room. The goal all along has been to destroy the server, and now the player has reached the goal. However, before doing so, the chatbot has a monologue discussing all the positive things a smart city can be used for, and that destroying the data may not be a good solution.

After the monologue, the player gets a choice: destroy the server or leave it be. Whichever he chooses, it is the end of the game.

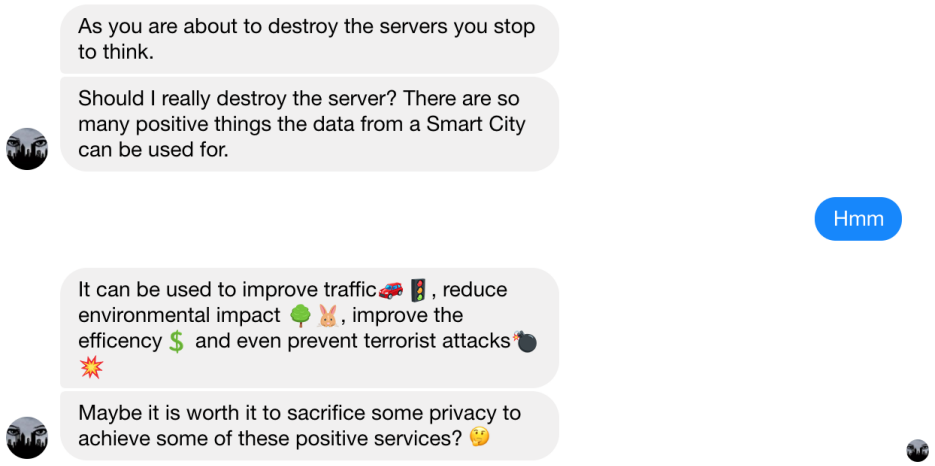

Figure 4.15: The player is presented with the bot monologue discussing the pros and cons of the smart city.

Learning Goal

The learning goal of the final level of the game is to teach the player that privacy decisions are not black and white. The goal for the majority of the game has been to destroy the data server, however when the player actually reaches the goal he is once again presented with the positive sides of a smart city, and all the good things collection of information can be used for - for example reduce environmental impact, improve traffic and even for counter-terrorism. As in real life, this is a privacy decision with trade-offs, and the player has to make the decision.

Learning Elements

In the final level of the game, the player has to make a choice. This is a game element from **consequential play**, where the player makes the decision to destroy the server or to leave

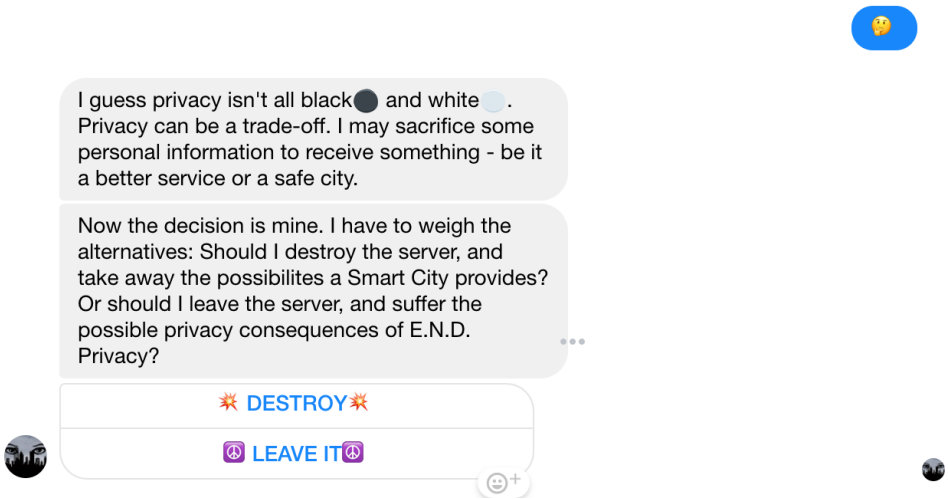

Figure 4.16: Finally, the player can choose to destroy or leave the server.

it. Before making the decision, a lot of the positive sides of a smart city is **repeated**. This lets the player reflect over whether to destroy the server or not. That is his choice, and is an analogy for all privacy decisions that are made. They are personal, and the trade-offs have to be considered.

Engagement Elements

The main engagement element in this level, is once again to see the consequences of one's actions. The level contains few game elements and is designed more to promote reflection in the mind of the player.

4.2.11 End Game Summary

After deciding whether to destroy the server or not, the game is over. The player is informed that privacy is a delicate subject, and that there isn't one correct answer to whether one should destroy the server or not. If the player destroys the server, the consequence is that the city of Metropolis goes back to being an ordinary (non-smart) city, but that the privacy of the citizens is kept intact. If the player leaves the server, Metropolis continues to be a smart city, but at the cost of the privacy of the citizens. Is it worth it? That's up to the player to decide.

The player is presented with statistics from his game session to further increase learning outcome:

- Quiz score, and questions answered incorrectly.
- Statements / Audio recordings score, and incorrect classifications. (Depending on which path the player chose)

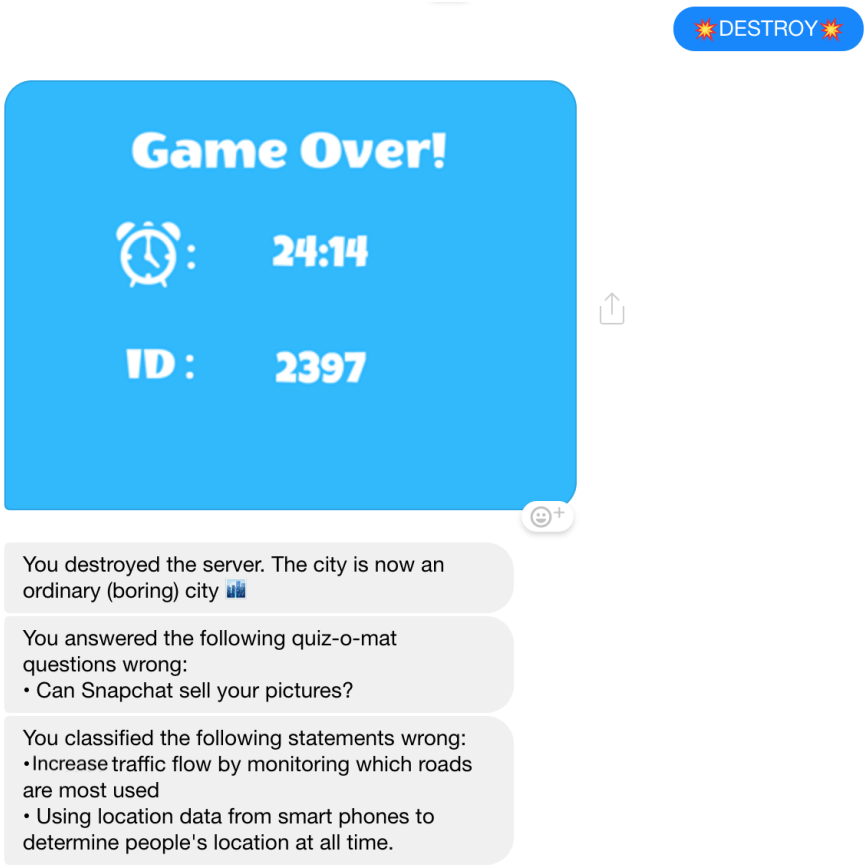

Figure 4.17: The ”game over” screen contains an image with the time used and player id, as well as a list of any wrong answered questions.

- Time spent.

And finally the possibility to play the game again.

Learning Goal

In the end game summary, no new information is presented. The learning goal is to repeat information that the player didn't answer correctly the first time around.

Learning Elements

This level is designed to be an **After-action review**. Reflection on the game-session after playing the game is an excellent way to increase the learning outcome for the player (Ravyse et al. 2017). The questions that were answered incorrectly are **repeated**, to give the player a final chance to review them.

Engagement Elements

There no play elements in this level, however the player gets to see the **consequences** of his choice on whether to destroy the server or not, which can be engaging.

Chapter 5

Technical Description

This chapter will present the technical implementation and design of the game PrivaCity, as well as technical difficulties encountered during development and testing. The goal of the chapter is to provide a rationale for design decisions, frameworks and technologies chosen.

5.1 System Architecture

The jungle of technologies, terms, and expressions when developing a chatbot may seem confusing and intimidating to the uninitiated. However, this section will try to clarify the architecture and technology behind PrivaCity. In Figure 5.1 an overview of the technologies used in the system is presented.

The game PrivaCity is a chatbot that can be interacted with on Facebook Messenger and in the web browser on the URL `http://privacity.herokuapp.com/`. On Facebook Messenger, the chatbot is not available to the public, but can be accessed upon request (read more in Difficulties Encountered in section 5.4). It has been implemented with Microsoft Bot Framework[1] using Node.js[2] to realize the logic. Node.js is a JavaScript run-time environment for writing server-side code. By using Microsoft Bot Framework, the chatbot isn't designed for one specific chat platform, but is rather a general chatbot which can be interacted with on several chat platforms.

To connect the chatbot to Facebook Messenger we have used Microsoft Bot Channel, hosted on Microsoft Azure. The advantage of using Microsoft Bot Channel[3] to connect to Messenger instead of connecting directly (which also is possible), is that the bot can easily be distributed to a wide array of other chat platforms, such as Slack, Skype, Telegram and even Email. If Facebook Messenger is down for maintenance one day, one can interact

[1] *Microsoft Bot Framework* (2018). `https://dev.botframework.com/`. (Visited on Feb. 19, 2018).
[2] *Node.js* (2018). `https://nodejs.org/`. (Visited on May 29, 2018).
[3] *Conversation as a Platform* (2016). `https://channel9.msdn.com/Events/Build/2016/C902`. (Visited on Feb. 19, 2018).

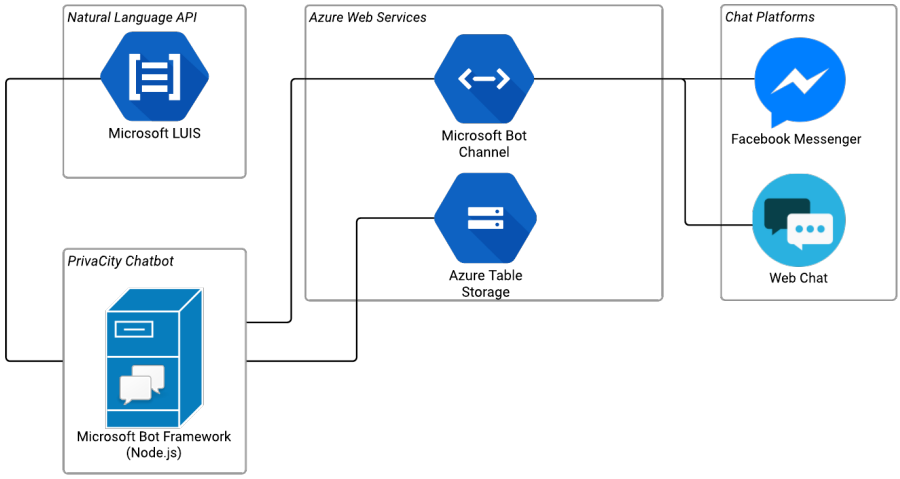

Figure 5.1: Deployment diagram overview of the PrivaCity system showing how the different components are connected.

directly with the chatbot in the web-browser - experiencing the same dialog. The Microsoft Bot Framework is discussed further in section 5.2

For natural language processing Microsoft LUIS[4] (Language Understanding Intelligent Service) is used. Natural language processing is used to determine what the player actually means when he says a sentence, i.e. ”Open the door”. LUIS is a machine learning based service, which we have trained to understand some sentences and determine what the player is intending to do. In Figure 5.2, the sequence diagram shows the example of the player saying ”Open the door” in level 0 of the game. When the utterance reaches LUIS, it determines that the users’ intent is to open something, and that the entity he wants to open is a door. Natural language processing and LUIS is discussed further in section 5.3.

To store persistent data, Azure Table Storage is utilized. Persistent data can be statistics from the game session, or information about the player, for instance, if he has interacted with the chatbot before.

Figure 5.1 is a diagram showing the overview of the different components is presented. Most of the components of the chatbot are based on the Microsoft and Azure ecosystem. This is because they have made it easy and convenient to use and integrate the components together. The chatbot itself is hosted on a web-server on Heroku Cloud Platform[5] because it is a free option. It could have been hosted on the Azure Web Services, like the Bot Channel and Table Storage, but Heroku is a free option.

[4] *Microsoft Language Understanding (LUIS)* (2018). `https://www.luis.ai/home`. (Visited on Apr. 24, 2018).

[5] *Heroku* (2018). `https://www.heroku.com/`. (Visited on Apr. 24, 2018).

5.2 Bot Framework

There exist several frameworks for creating chatbots. As explained in the technology discussion in the state of the art (section 3.3.1), a lot of the reviewed chatbots were implemented using Artificial Intelligence Markup Language (AIML) as a knowledge-base to support pattern-matching. This often required the developer to have proficient knowledge and understanding of complex artificial intelligence concepts. However, as many of the big technology companies have invested a lot of resources into chatbot development, today there exists a lot of possible frameworks to choose from, which has made it easy to create a complex chatbot.

5.2.1 Microsoft Bot Framework

The framework with the most users and documentation is often a good choice when selecting which to work with. In the case of chatbots that is Microsoft Bot Framework. SDKs (Software Development Kits) are available for both Node.js and .NET, providing the same opportunities for both environments.

The advantages of using Microsoft Bot Framework from our point of view are:

- Good documentation and tutorials.
- Active community for developers.
- Supports multiple chat platforms. Write code once, run anywhere. (Facebook Messenger, Web Browser, Skype, etc...)
- Developed and maintained by Microsoft.
- Easy to integrate with other Microsoft services. (Analytics, Storage, LUIS)
- The authors have some experience with the framework.

And some of the challenges are:

- Steep learning curve.
- Can be considered ”overkill” for a privacy awareness game. It is made to support large enterprises.
- Difficult to integrate with non-Microsoft services. Have to figure out a lot on your own.

How It Works

The framework works by dividing the conversational logic into **dialogs**. In the case of PrivaCity, we want different logic for the different levels of the game. If a player says ”Open the door” in level 0, where there is a door, we want to check if the player has already found the key. However, if he says ”Open the door” during the job interview in level 5.1, where there is no door to interact with, we don’t want to open the door that was present in level 0. This is handled by making each of the game levels into their own ”dialog” with its own logic for how the player can interact with objects.

5.2.2 Other Frameworks

Before selecting Microsoft Bot Framework as the framework for the PrivaCity game, we considered several other possibilities.

One possibility is developing directly for the Facebook Messenger platform using the Facebook for Developers Messenger platform[6]. The advantage of implementing the bot directly with Messenger is that the complexity of the system is reduced (fewer components), and having access to some functionality that isn't available in more general frameworks, targeting several chat platforms. One such functionality is "Chat Extensions"[7], which would provide the opportunity of implementing the game as a multiplayer experience. However, a disadvantage of using the Facebook for Developers Messenger platform directly is that one is restricted to the Facebook Messenger platform to communicate with players. Furthermore, a lot of the functionality on Facebook Messenger is available using a general framework to build the bot, such as buttons, lists, and quick-replies.

A framework which targets a variety of chat platforms is Botkit[8]. Like with Microsoft Bot Framework, one creates a "general" bot which can be distributed to several channels. From a developer point of view, it seems very similar to Microsoft Bot Framework with a lot of the same possibilities. One can even use the same "language" (Node.js). However, as it isn't backed by a giant corporation like Microsoft, we evaluated it to not be as attractive as Microsoft Bot Framework. However, Microsoft Bot Framework is big and complex, and Botkit seems like a good way to get a bot up and running quickly with a kinder learning curve for the developer.

5.3 Natural Language Processing

Natural Language Processing (NLP) is the processing of the language we, human beings, use to express ourselves into terms that a computer can understand. When communicating with PrivaCity, the player uses a combination of buttons and natural language. To understand the natural language of the player we use the Microsoft LUIS, which has been trained specifically for PrivaCity.

5.3.1 Microsft LUIS

In Microsoft LUIS there are two main concepts one must understand: **intent** and **entity**. The intent is what the user wants to do, and the entity is what he wants to do it *with*. In the example of "Open the door", shown in Figure 5.2, the intent of the player is to open something. The thing that he wants to open, the entity, is the door.

Understanding the sentence "Open the door" is not something that LUIS can do out of the box. Since we, as developers, know that the action to open things is something that is crucial to the gameplay of PrivaCity, we have defined in LUIS the intent 'open'. After creating an intent, you must imagine all the possible ways a player could express the want

[6] *Facebook for developers - Messenger Platform* (2018). `https://developers.facebook.com/docs/messenger-platform/`. (Visited on Feb. 21, 2018).

[7] *Chat Extensions* (2018). `https://developers.facebook.com/docs/messenger-platform/guides/chat-extensions`. (Visited on Apr. 24, 2018).

[8] *Botkit* (2018). `https://botkit.ai/`. (Visited on Apr. 24, 2018).

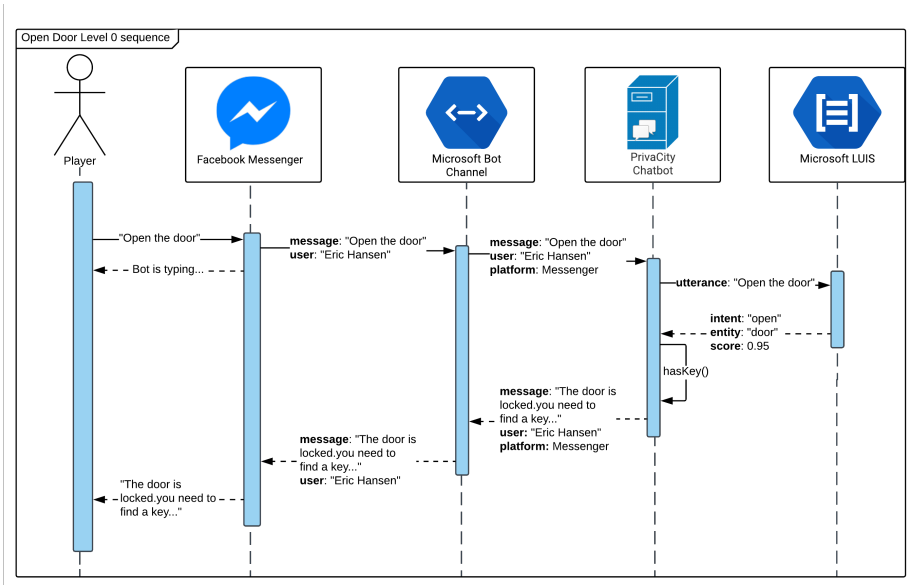

Figure 5.2: Sequence diagram showing the interaction between components for the message ”Open the door” in level 0. In this example the player has not yet found the key.

to open something. Then you ”train” LUIS to understand a multitude of utterances which we predict can mean to open something. ”open it”, ”unlock the door”, ”go out the door” or simply ”open”, are examples of possible things a player can say to express the intent of opening a door. After having provided these sentences as input to LUIS, it is trained on the sentences provided. A player doesn’t necessarily have to say exactly one of the sentences LUIS has been trained on. Based on machine-learning it tries to understand variations that may have the same intent. Each time LUIS classifies an utterance, it does so with a score, as one can see in Figure 5.2. The score is a number between 0 and 1 of how sure it is about its classification.

Once the intent of ’open’ has been defined and trained, we want to teach LUIS which things can be opened. We need to know if a player said ”Open the box” or ”Open the door”. The intent is the same (open), but the entity is different. Since opening the door is something the player can do in our game, we define ’door’ as an entity. Then we have to provide sentences as input to LUIS, classify which words can be used to describe the entity ’door’, and train LUIS again. A sentence can even have several entities, i.e. ”Open the *door* with the *key*”. If trained correctly, LUIS should tell us that the intent is ’open’, and that the entities ’door’ and ’key’ was provided. The developer must then implement the logic for how to handle the opening of the door.

As explained earlier, we want different interactions with objects in the different levels of the game PrivaCity. The action to ”open the door” can be said in both level 0, where you need a key, and in level 5.2, where you need a password. However, LUIS doesn’t know if the player is in level 0 or in level 5.2 - all he knows is that the player wants to open a door.

Therefore, as each level is a different ”dialog” in the Microsoft Bot Framework, in both level 0 and 5.2 different logic has been implemented for handling the intent ”open”.

5.3.2 Other NLP Services

There exist several viable NLP services targeted at chatbots. Dialogflow[9] (formerly known as Api.ai) is a service owned by Google. As with LUIS, the main concepts are intents and entities. With Dialogflow it is possible to create an entire functional chatbot on the platform without having to write a single line of code. However, it can also be used in the same way as LUIS, as an API for a chatbot to extract intents and entities from utterances.

Wit.ai[10] is another interesting service. It is owned by Facebook and is therefore the preferred NLP service when developing a bot specifically for Facebook Messenger. It works in the same way as LUIS and Dialogflow, defining intents and entities in sentences. It used to be possible to create an entire chatbot on the Wit.ai platform, but it has later been deprecated. The focus in 2018 has shifted towards becoming an NLP API for chatbots, just like LUIS.

All three of the mentioned NLP services provide much of the same functionality to the chatbot. Each of the services is owned by giant technology companies (Microsoft, Google, and Facebook), and all use machine learning to enhance the experience. For PrivaCity, LUIS was chosen as the NLP service. The same functionality could be achieved by either of the other mentioned services, but LUIS was chosen because of the simplicity of integrating several Microsoft services.

5.4 Difficulties Encountered

5.4.1 Facebook Messenger and App Review

In the middle of the development of the PrivaCity chatbot, the news ”scandal” about Facebook and Cambridge Analytica came to light (explained in Chapter 2). It made this serious game extra relevant, but also lead to some technical difficulties. As a result of the press coverage, Facebook put a ”freeze” on all page accesses for developers. When interacting with PrivaCity on Facebook Messenger it is actually a ”Facebook Page” one interacts with. Luckily, we had set up the connection between the chatbot and Facebook prior to the freeze. If not, using Facebook Messenger would have been impossible. The access freeze also applied to creating test users for the app, meaning that it was impossible to create mock Facebook users to use in user testing.

One of the main reasons for using Facebook Messenger as the main platform for the chatbot game was the results from the user study (described in section 2.5) where 100% users stated that they use Facebook messenger. However, for a chatbot to be open to the public on Facebook Messenger, it has to pass an ”app-review” by Facebook employees. In the turmoil following the scandal, all app-reviews were put on hold for several weeks. When app-reviews was re-opened there was a bug on Facebook’s side, making

[9] *Dialogflow - Build natural and rich conversational experiences* (2018). `https://dialogflow.com/`. (Visited on Feb. 21, 2018).

[10] *Wit.ai - Natural Language for Developers* (2018). `https://wit.ai/`. (Visited on Apr. 24, 2018).

it impossible to pass the app-review and make the chatbot available to the public. We opened a bug-report which can be seen here: `https://developers.facebook.com/support/bugs/1633010340146820/`. The issue was not resolved until May 23rd - too late for the main evaluation of PrivaCity. If the reader of this thesis desires to interact with the chatbot on Facebook Messenger, please contact the authors Erlend Berger or Torjus Sæthre to be added as test users of the bot. In the meantime, we suggest using Web Chat.

Luckily, since PrivaCity was developed with Microsoft Bot Framework, it was easy to deploy the chatbot to other chat platforms. Because using the Facebook Messenger platform for the main evaluation resulted impossible, "Web Chat" is the chat platform used for the main evaluation. Web Chat is an embedded HTML code snippet which can be included in any web-page, where anyone with a web browser can interact with the chatbot. The interaction with the chatbot is more "smooth" on Facebook Messenger, but Web Chat is a viable second option. In the pilot testing (Chapter 6) Facebook Messenger was the chat platform used, since there was a low number of participants and we could add them as "testers" of the chatbot. In the main evaluation (Chapter 7) this was not feasible, and Web Chat was used.

One advantage of using Web Chat is the privacy implications of using Facebook Messenger. When chatting with the bot on Facebook the player needs a Facebook profile, and the administrators of the Facebook page can see the full conversation (including names of the participants). When interacting with the chatbot over Web Chat it does not require any log-in, and the player is completely anonymous. This is better from a research perspective, and the player is only known by a unique ID generated in the game session.

5.4.2 Pricing Tiers

In the first phase of development, the chatbot (which is basically a web server) was hosted on Azure Web Services alongside the storage and "Bot Channel". However, hosting the bot on Azure was a pricey option, with few advantages over more reasonably priced competitors. We therefore decided to migrate the hosting of the bot to Heroku Cloud Platform[11], which is a free option offering the same capabilities. The free tiers of "Bot Channel" and "LUIS" API have request limits of 10000 requests per month. For development this was sufficient, but for the main evaluation of the bot with over 100 participants, it was not enough. Before the evaluation, we therefore upgraded to a "pay for what you use" pricing tier, in order to avoid running out of free requests in the middle of an evaluation session.

5.4.3 Training the Natural Language Processing API

Training the NLP service LUIS turned out to be more tedious and comprehensive than anticipated. The developer has to foresee every possible way a player can say something. LUIS is quite 'dumb', and can't figure out many variations on its own. Therefore, to have a well-functioning chatbot one either needs a large data set of user data on how to express an intent, or spend many hours or days coming up with and fine-tuning utterances into intents and entities.

[11] *Heroku* (2018). `https://www.heroku.com/`. (Visited on Apr. 24, 2018).

Since the participants in the main evaluation testing the game are Norwegian teenagers, it would be intuitive if the language of the chatbot was in their native tongue. But NLP is an immature field, and few services have Norwegian as a supported language. This is a technical limitation of the system which might affect the learning outcome of the serious game.

Chapter 6

First Pilot Test

This chapter will present the first pilot testing of the game PrivaCity. It describes the purpose of the pilot testing, the participants, how the process was performed, the results, and finally a discussion. The process is inspired by Oates (2005).

6.1 Purpose

The main purpose of the first pilot test is to evaluate the usability of the game, and if the player understands how to play. Another important goal is to discover unwanted game behavior, where the game does not respond, freezes, crashes, or provides the wrong response. As the game must process and understand the textual input from the user, it can be difficult for the game to interpret all possible utterances. Utterances like ”Open the door” and ”Unlock with key” has the same intent from the user, but looks widely different for the language processor. Running a pilot test with external users can help evaluate which utterances the bot interprets correctly, as well as discover multiple utterances that are not yet covered by the game and subsequently train the bot. These errors are considered minor changes and will not be included in the changelog (Table 6.2), but are presented in Appendix C.

The pilot test will also be used as an opportunity to test and evaluate the post-game questionnaire. Evaluating the questionnaire is important to ensure that it gathers the desired data, and to see if the respondents have difficulties completing it. Peterson states that ”the quality of the information obtained from a questionnaire is directly proportional to the quality of the questionnaire” (Peterson 2000, p. 12), highlighting the importance.

Two important questions the researchers looked to get an answer to was how much time it takes to complete the game, as well as how difficult it is. Under difficulty it was important to look at the language and get feedback on the difficulty and if the participants think it is appropriate for the intended target audience.

6.2 Participants

The participants of the first pilot tests were 7 Computer Science master students - six males and one female. They were recruited voluntarily to participate in the pilot test. The serious game PrivaCity is designed for high school students aged 16-18, and the participants in this pilot test likely have more knowledge about privacy than the average high school student. Therefore one must consider the difference in skill levels when drawing results from the tests. However, the main purpose of the first pilot test is to evaluate the usability of the game and if the player understands how to play. The participants serve this purpose even though they are outside the target group.

6.3 Process

Each participant was allocated a total of 1 hour to play the game, answer the questionnaire and participate in an unstructured interview, in that order. With a total of 7 students, the information from the qualitative data generation methods (interview and observations) were considered more important than the quantitative (questionnaire results). To strengthen the validity of the qualitative data, two different types of data triangulation were used: Observations made during the user testing was later compared against data from the interview (Method triangulation), and during the user testing the two facilitators also made separate observations and notes (Investigator triangulation). The entire process was audio recorded.

Before beginning the pilot test the player was informed that participation was voluntary and was presented an ”information and consent form” to sign, stating that all data is anonymous (can be seen in Appendix E). The player was then informed that he would not receive help from the facilitators during the game and was encouraged to think out loud. Two facilitators were present, one sitting behind the player observing his actions, while the second was monitoring the chat and game log on a separate computer screen. The researchers were only to intervene if the player was stuck in a section for a long period of time, in order to help game progress. The observers noted any occurrence of unwanted behavior occurred, as well as utterances classified incorrectly by the chatbot. The observations made were later discussed in the interview, where the player had a possibility to comment on the observations made. The game never crashed during the testing, so all participants got to complete their game session.

The player was asked to use his own computer and sign into his Facebook profile. He then received a request to become a test user and a link to the chat were the PrivaCity game is played. After playing the game, the player was presented with an anonymous ID and a link to the questionnaire. Once having completed the questionnaire, the player was asked to participate in a loose and unstructured interview with the two facilitators. The reason for this type of interview style, as opposed to a more structured set of questions, is to not limit the player, but rather let him speak his mind more freely - as discussed by Crabtree, Tolmie, and Knight (2017). Questions were often based on the observations made during testing. As a part of the interview, players who finished the game in a short amount of time were asked if they would like to play the game path they did not choose in their first run through. They were later asked how they would compare the parts in terms of difficulty and entertainment.

The first 4 participants played individually in separate sessions, while the final 3 participants did a simultaneous test. This was done in order to evaluate the game when multiple users played at the same time. Cooperation between the participants was not allowed. When the participants played the game simultaneously they participated in a group interview after the game session together.

6.3.1 Questionnaire

The post-game questionnaire was created to gather data about the player background, the general impression of the game, engagement value and learning outcome. After playing the game, the player receives a link to the questionnaire from the chatbot. The player is asked to enter their unique ID given to him at the end of the game, so that the researchers can link responses to chat logs and preserve anonymity. For background, the player is requested to enter gender and age, as well as provide information of how much time he spends playing games and whether he has interacted with chatbots before.

In order to evaluate each level and their game elements in regards to engagement value and learning outcome, the questionnaire incorporates a 5-scale Likert (Likert 1932) question to gather positive or negative response to each level (see Figure 6.1). As the game includes different paths, and the player will not visit every level, the game has been designed in such a way that the player will receive a questionnaire that only includes the levels he visited. Forcing the player to remember which levels he visited could potentially lead to invalid responses and contradicts the ”Recognition rather than recall” guideline by Nielsen (1995).

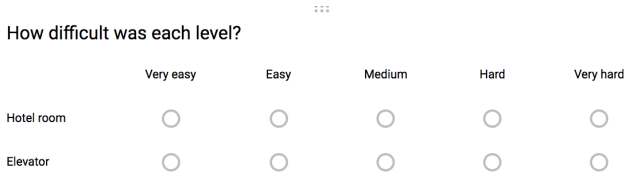

Figure 6.1: Example of 5-scale question for the different levels

To finish up the questionnaire, the respondents are asked if they have learned something, if they feel more aware and if they will change their behavior towards privacy. Lastly, there is a text field for written feedback. The full questionnaire can be seen in Appendix B.

6.4 Results

This section will present the results obtained through observations, interviews and the questionnaire.

The game sessions of the 7 participants is shown in Table 6.1.

Table 6.1: Table showing the game sessions of the 7 participants. Including time used, path chosen, whether they decided to destroy or leave the server, and if they tried both paths.

Player ID	Time used	Path	Server decision	Tried both paths
1020	15:53	Infiltration	Destroy	Yes
1598	35:31	Sneaky	Leave	No
1784	18:35	Infiltration	Leave	Yes
1551	24:52	Sneaky	Leave	No
8117	18:13	Sneaky	Destroy	No
6906	19:49	Sneaky	Destroy	No
5070	20:36	Sneaky	Leave	No

6.4.1 Observations

There was observed little unwanted game behavior, and in only one case the chatbot displayed a ”bug” by showing an emoji signaling that a game character was speaking, when that wasn't the case.

The game had few problems understanding utterances of the players. Player 1598 resorted to using only one word to communicate with the chatbot, i.e. ”door” when wanting to open the door. This resulted in some unwanted behavior from the chatbot where it didn't act as the player expected. The user showed obvious signs of frustration that the chatbot didn't understand him. When the desired action didn't work, the player got suggestions from the chatbot of which actions could be performed.

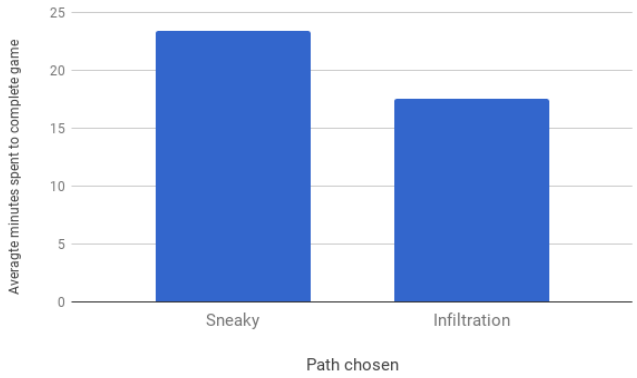

Figure 6.2: Average time spent to complete the game, depending on which path chosen in the game.

The results show that the players spend between 15-35 minutes to complete the game. Time spent to complete the game is influenced by which ”path” the player chooses through the game. As shown in Figure 6.2, the average time spent to complete the game when playing the sneaky plan is 23,4 minutes, whereas with infiltration it is 17,5 minutes.

The observations during the user tests showed that the players quickly understood how

to play and interact with the chatbot. A trend is that the players mainly used text to interact with the chatbot at the beginning of the game, but transitioned towards using more and more buttons as the game progressed.

The observed difficulty seemed to be easy to medium. Most of the players managed to complete most tasks without getting stuck or getting many hints from the chatbot. Player 1598 got stuck in level 4.2 and needed some help thinking out loud from the observers. An observation is that the players that seemed to skim read what the chatbot said got more stuck, whereas the players spending more time actually reading what the bot said finished the game faster.

The players were aware that the goal of the game was to increase the privacy awareness of the player. This also seemed to make them consider privacy aspects in every action of the game. When understanding that the password for the elevator in level 1 was his full name player 1551 exclaimed:

> ”Hmm, should I enter my full name in an elevator...”

The game seemed able to make the players reflect on privacy decisions, and was surprised by some of the information presented. Especially when using examples from the ”real world” it provoked a reaction from the player.

> ”Wow, scary!” - Player 1020 when learning that the real-life children’s doll Cayla was recording everything.[1]

In the final level, when deciding whether or not to destroy the server, several players spent around a minute thinking and scrolling the chat before making a decision. Other players made the decision in seconds. Player 1551 reflected back to what the ”friend” told the player - that it was rumored that the government hid microphones in children toys. If the rumors were true he wanted to destroy the server, but if they weren’t he didn’t want to destroy it.

6.4.2 Interviews

The unstructured interviews confirm many of the observations made during the user tests. The overall impression of the participants was that the game was quite easy to complete, and that the usability is good. The reason why the game was easy is that it provides a lot of hints. Especially if the player tries to do an action not anticipated by the chatbot, it provides hints for possible actions in the level - making it easy to progress the game. Some of the participants think the game would have been more entertaining if it was more challenging to complete the levels, and receive fewer hints. However, player 1598 (who spent the most time to complete the game) stated that the game was not easy to complete and without the hints, he would have been stuck and not able to finish the game.

The general impression from the interviews is that the players choosing the ”sneaky” path found the game more entertaining. It was more challenging, and gave a feeling similar to completing an ”escape room”. The players that tried both paths confirmed that ”sneaky”

[1] *Call for privacy probes over Cayla doll and i-Que toys* (2018). `http://www.bbc.com/news/technology-38222472`. (Visited on Mar. 7, 2018).

was more entertaining, but that ”infiltration” was more focused on privacy and that the learning outcome might be higher from that path.

When interviewed about how they interacted with the chatbot, in textual form versus buttons, the participants stated that in the beginning, they tried to use mostly text, but as the game progressed they used more and more buttons. The reason was that using buttons to choose actions was a faster way to progress the game than to actually write text. This confirms the observations about text versus buttons. One participant tried to use text in the first level saying ”walk out the door”, but the chatbot didn't understand what he meant. He therefore assumed that the chatbot was too dumb to understand him and preferred buttons for the rest of the game session.

The emoji usage seems to be regarded as a positive addition to the game. The players said that it helped break up long and boring text, but that the most important aspect is that the emojis clarify which objects can be interacted with. The players believed this to make the usability of the game a lot better, as it would result in fewer ”dead ends” where the player tries to interact with something that can't be interacted with. Player 1784 made the following statement during the interview:

> ”The emojis show which objects you can interact with. With just text, it would be difficult to know.”

The participants found the language usage in the game to be understandable and not too complicated. Since they are not in the target group of the game, they were asked if they thought a teenager would have the same impression. The participants believe the language won't be too troublesome for Norwegian teenagers, but that maybe some words should be simplified. ”Deprive” is used as an example of words that can be perceived as confusing. This is also something they believe emojis can help simplify.

Whether the participants think they learned something about privacy and become more aware from playing the game is mixed. With a high knowledge about privacy before starting the game, most of the players answered the majority of the quiz questions and privacy classifications correctly. However, confirming the observations, seeing examples from the real life was something that they found educational. Even though they knew that constantly recording all conversations with a toy is a privacy violation, they were not aware that it actually had happened in real life with the doll Cayla. The participants said that providing an explanation for the correct answer to a quiz questions was very instructive. Especially when they answered incorrectly they wanted to know why.

6.4.3 Questionnaire

The results from the accompanying questionnaire give more specific insight into the levels of the game, as the participants evaluated the difficulty and entertainment. Figure 6.3 shows a graph explaining how difficult each of the levels is. One can see a slight increase of difficulty as the game progresses, especially in the ”Sneaky” path of the game (Level 4.1 and 4.2). Level 4.2 is considered the most difficult level of the game. In comparison, the ”Infiltration” part of the game (Level 5.1 and 5.2) shows a lower perceived difficulty.

Figure 6.4 shows how entertaining each of the game levels is. The results show that the levels consistently score between 3 (Medium) and 4 (Fun). Level, 4.2 is rated as the most

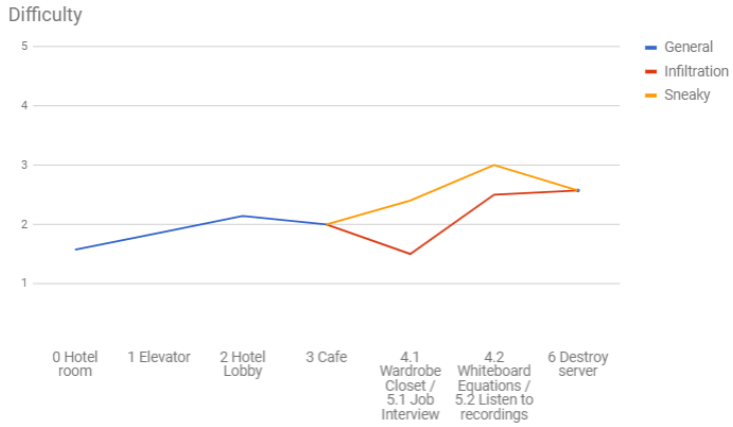

Figure 6.3: How difficult each of the game levels is. From 1: Very easy to 5: Very hard.

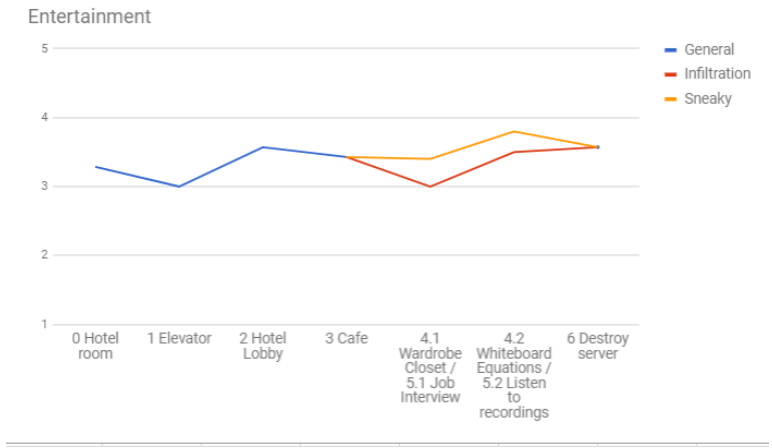

Figure 6.4: How entertaining each of the game levels is. From 1: Very boring to 5: Very fun.

entertaining one level of the game. The ”Sneaky” path is rated slightly above ”Infiltration” for entertainment value.

The participants were asked which game elements they believed to have helped raise their privacy awareness, shown in Figure 6.5. 100% of the participants consider the Quiz learning element to be contributing to an increased privacy awareness. The second most contributing learning element is ”Consequences of actions” at 71%. None of the participants believe that the elements Summary or Rewards increased their privacy awareness.

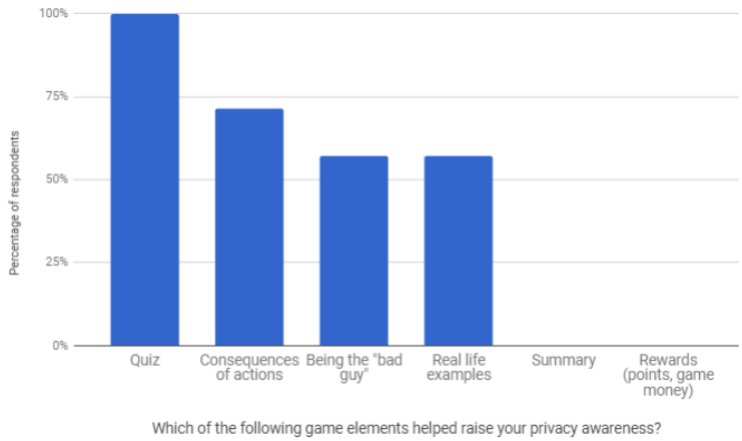

Figure 6.5: Perceived learning elements in the game that raise privacy awareness of the player.

In Figure 6.6 the regarded change in awareness and behavior of the participants from playing the game is presented. The results show that the participants learned about privacy in smart cities to some extent from playing the game. They also believe to have slightly raised awareness towards privacy in general. On the point of behavior change, the participants show neither agreement or disagreement that it will change as a result of playing PrivaCity.

6.5 Discussion

The first pilot test has been run with participants not in the target group of the serious game PrivaCity, and with a low number of participants. The results are therefore not necessarily a good indication of whether the game achieves its learning goal, which is to raise the privacy awareness of its players. However, as explained, the purpose of the first pilot test is more focused on testing the usability of the game and discover unwanted behavior. With a low number of participants, the qualitative data is more important than the quantitative, and is weighted as such. Evaluating the research questions of what learning and engagement elements work well in a chatbot serious game is difficult to do at this stage, but some conclusions can be inferred.

Figure 6.6: Awareness and behaviour change recorded in the participants.

6.5.1 Usability

The results show that the usability of PrivaCity is good. There are few bugs and little unwanted behavior. The participants are people with high technical capabilities, and it is therefore likely that they use the chatbot as expected. For this first pilot test, the authors have been present at all user tests in case something was to go wrong. The game acted as expected both when played individually, and when played simultaneously by multiple participants. Having proven good usability, we believe that the game is ready to be published so that for the next test participants can access it with a hyperlink and the authors don't need to be on location.

One important experience from the pilot test is that it is very important that the chatbot acts as the user expects at the beginning of the game. If the chatbot acted unexpected and didn't understand the user in the first level, the participant was reluctant to use full sentences for the rest of the game. Unexpected behavior later in the game is not as serious. Therefore the chatbot needs to build confidence with the player, as to not impede his curiosity.

6.5.2 Difficulty

The results show that the perceived difficulty of the game is quite low, both for tasks to complete the levels and the privacy awareness related theory. This is expected from participants with a high technical understanding and a high knowledge of privacy. If the participants in this first user test found the game to be challenging, it would probably be too difficult for a "normal" teenager.

In Chapter 2 we introduced the concept of flow. A game should strive towards keeping the player in a state of flow by increasing the level of difficulty when the player progresses through the game and improves his skill level. Even with a total of 7 test participants, Figure 6.3 can give an indication of an increasing difficulty throughout the game. By

increasing the difficulty as the player gets more familiar with game mechanics and hence increases his skill level, the game can help the player stay in a state of flow where the challenges are not too difficult, nor too easy. Another aspect of keeping players in a state of flow was to aid the players with hints if they find it too difficult, as well as provide buttons with suggested actions. A few players that struggled in different sections commented on the hints, saying that they were helpful to their progress in the game.

6.5.3 Path Chosen

To let the player see the impacts of his actions and truly become an active participant in the game is the idea behind *Consequential Play* (described in section 3.2.3). One of the ways to do this in PrivaCity is that the player chooses which plan to follow to complete the goal of the game. These are the plans for ”Sneaky” and ”Infiltration”.

The results show that there is some difference in difficulty between the two levels. The players that chose the infiltration path, find the game easier and spend less time to complete the game. The initial results show that the sneaky path is considered more challenging, while at the same time the more entertaining of the two. This correlation between entertainment and difficulty as well as relation to learning outcome should be further studied as the sample data grows.

6.5.4 Learning Elements

All participants stated in the questionnaire (Figure 6.5) that a learning element they believe to be effective, is a **quiz**. In the interview after the test, multiple participants talked about the explanations to each quiz questions. Alongside with feedback on whether they got the question right, the explanation was very helpful to get a better understanding and deeper insight into the problem. Some participants were particularly intrigued by explanations that included **real world scenarios**. This might indicate that **providing information** can be an effective learning element in the game.

Several participants also believed that seeing the **consequences of your actions** in the game would be beneficial to the learning outcome. Almost 60% of the participants noted that **being the ”bad guy”** would be an efficient learning element.

It is important to consider that what is being discussed in this section is the player’s perceived learning, what the player believes he has learned, as opposed to testing the actual knowledge of the player before and after playing the game.

6.5.5 Engagement Elements

Figure 6.4 shows how entertaining each of the game levels is to the participants. These results are confirmed by the observations and interviews where it seemed like the ”escape room” inspired tasks of level 4.1 and 4.2 in the sneaky path were considered to be the most entertaining ones. In Table 4.3 in the game design it is shown that the main engagement elements for level 4.1 and 4.2 are **curiosity**. The player needs to explore the levels in order to find clues to progress the game.

Infiltration, with level 5.1 and 5.2 were considered less entertaining. The main engagement elements in these levels were **role-playing**, **chatbot character** and **funny**. From

these initial findings, it might seem that these engagement game elements are not as effective in a chatbot serious game as **curiosity**.

An interesting observation is that two of the three levels (4.2 and 6) that score highest on entertainment only have one engagement element connected to them. Level 4.2 has **curiosity** and level 6 has **consequential play**. This might indicate that it is not necessarily a great idea to throw as many engagement elements at the player as possible, but rather to limit the number of elements and design them properly.

6.5.6 Raised Privacy Awareness

The goal of this pilot test was not to evaluate if the privacy awareness of the participants was raised. However, some interesting findings can be seen in the results. Figure 6.6 shows that even though the players learned something about privacy in smart cities, they weren't necessarily more aware towards privacy in general. And that even though they became more aware, they were not as likely to change their behavior towards privacy. These results are in line with the findings made in the specialization project (Berger and Sæthre 2017). As described in section 2.2, learning about something is a good way to raise awareness, but that the subject doesn't necessarily change his behavior as a result of raised awareness (Blythe and Coventry 2012). Furthermore, it is very difficult to teach one way "to do things right", as the privacy preferences will differ from individual to individual and choices depend heavily on the context of the situation.

6.5.7 Changes as a Result of First Pilot Test

To organize changes and suggested changes, we implemented a changelog. All suggested changes were added to the log awaiting sufficient reasoning and support before being implemented in the game. After evaluating all suggested changes, several changes were made to the game PrivaCity, shown in Table 6.2.

In addition to changes in the changelog, at least 40 minor changes, including utterance interpretation and bug-fixes were resolved and implemented as a direct result of the pilot tests. The full list of minor changes and utterances can be seen in Appendix C.

The questionnaire used to gather results was also evaluated in the first pilot test. Since the quality was satisfactory, only small changes were made, shown in Table 6.3.

Table 6.2: Changelog showing the changes made to the game PrivaCity after the first pilot test.

ID	Level	Description	Reason	Importance
1	1	Remove capital letter in elevator password.	Make the task harder. Too easy for multiple users in pilot tests.	Low
2	4.2	Add specific hint for when password is obtained.	A user found the password, but wasn't able to use it.	Medium
3	5.1, 5.2	Easier to fail infiltration path to get game experience.	Infiltration path is too easy for several users. Players that fail end up in level 4.2.	Medium
4	3	The friend explains that he has already given the player the password/phone number, and that he can't say it aloud since there are "eyes everywhere".	Users didn't understand why the number was hidden.	Medium
5	4.1	Make it clear that the sheet of paper is the plan of the new city council.	Users didn't understand that the statements were from the E.N.D. Privacy party.	Low
6	All	Save all utterances not classified correctly by the chatbot to a database.	Easier to train LUIS when all utterance issues are in one place. Don't need to find them separately.	Medium
7	Summary	Automatically save statistics to database when game is finished.	Easier to use the results without entering data manually.	Medium
8	4.2	Increase size of text in newspaper and message images.	The font was too small to read comfortably for several users.	Medium

Table 6.3: Changelog showing the changes made to the questionnaire after the first pilot test.

ID	Description	Reason	Importance
1	Add age, gender, and what types of games to questionnaire.	Could be interesting to see if there is a correlation between this data and game performance.	Medium
2	Change the scale for how many hours per week gaming to correspond with a defined scale. I.e casual gamer, hardcore, etc...	Easier to classify the users, rather than having arbitrary ranges.	Low

Chapter 7

Main Evaluation

In the pilot test (Chapter 6) PrivaCity was evaluated and deemed to have satisfiable usability and little enough unwanted behavior to be evaluated in the main evaluation with participants from the target group of the game.

7.1 The State of PrivaCity

During the pilot tests several minor changes were made to the game (see Appendix C). After the pilot testing was done, some bigger changes were identified and made to the game. These were presented in the changelog in Table 6.2. The general trend was that the difficulty was slightly increased in the game. Especially in the infiltration path, which was deemed a bit too easy. To simplify collecting results for the authors some automatic data collection during the game was implemented.

In the pilot tests, Facebook Messenger was used as the chat-platform to test the game PrivaCity. This was done by manually adding the participants as 'test users' of the app, which was not feasible in the main evaluation. For everyone to be able to use Facebook Messenger the app has to pass app-review in order to become public (explained in "Difficulties Encountered" in section 5.4). Due to a bug on Facebook's side, the app was not reviewed in time to become public before the main evaluation. As a result, the Web-Chat platform is used to test PrivaCity in this evaluation. The game is available to everyone at the URL: `http://privacity.herokuapp.com/`.

The change from Facebook Messenger to Web-chat required some changes to be made to the game. In level 1, the password to open the elevator used to be the name of the player, which was obtained through his Facebook account. In the Web-chat the bot does not have access to the player's name, as it doesn't require any log-in to play. To account for this, the password was changed to "password" which can be obtained by solving a pigpen cipher[1] shown in figure 7.1. The player receives the encoded password when attempting to take

[1] *Pigpen Cipher* (2018). `https://en.wikipedia.org/wiki/Pigpen_cipher`. (Visited on May 10, 2018).

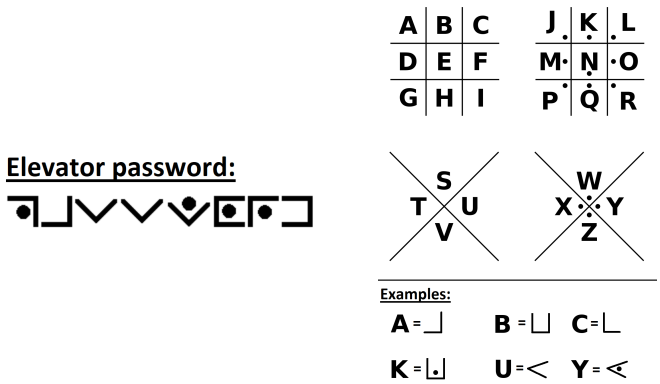

Figure 7.1: Pigpen cipher from PrivaCity to obtain the elevator password. The solution to the riddle is ”password”.

the elevator, and must find the cipher key hidden in the hallway in order to decode the password and enter the elevator. Should the player not be able to solve it, he will receive hints in the form of letters

7.2 Purpose

The purpose of the main evaluation is to evaluate the serious game PrivaCity. The focus is on the learning outcome the participants receive from playing the game, identifying learning game elements which work well in a chatbot serious game for privacy awareness. The focus is also on the engagement ability of the game, identifying the engagement elements which work well in a chatbot game. The difficulty of the game has earlier been evaluated by participants outside of the target group, but will be re-evaluated in the main evaluation as it is an important element to keep the player engaged. The results and discussion will help answer the research questions **RQ1.2** and **RQ1.3**. The usability of the game will also be re-evaluated with participants from the target group.

The results are used as a foundation for creating a set of general guidelines for chatbot serious games for raising privacy awareness, which will be presented in Chapter 8.

7.3 Participants

The participants in the main evaluation of PrivaCity are Norwegian teenagers. The teenagers are middle school (Ungdomsskole) and high school students (VGS). In Table 7.1 an overview of the participating classes is presented.

7.3.1 Class A

One of the groups who participated was a 9th grade middle school class, with an even distribution between males and females. This group of participants is called Class A and

Table 7.1: The school classes who participated in the main evaluation of PrivaCity.

Class	Time allowed	No. players	No. finishers	Age	Educational level
A	51 min	30	21	13-14	Ungdomsskole
B	29 min	18	12	16-17	VGS
C	25 min	15	2	18-19	VGS
D	36 min	25	22	16-17	VGS
F	46 min	16	13	14-15	Ungdomsskole

were of age 13-14 years. They were 30 participants in total.

The main evaluation of PrivaCity is aimed at Norwegian teenagers, but with the main focus on high school students because the narrative and interactions of the game are in English. The inclusion of these participants will show how the serious game work for a younger audience, and maybe result in an expanded target group of the game.

7.3.2 Class B

Class B is an ICT first grade high school class of age 16-17. All 18 participants are male.

7.3.3 Class C

Class C is a general studies third grade high school class, age 18-19. The participants are an even distribution between males and females. Due to exams and the Norwegian graduation celebration (russetid), there were fewer students than normally in class, and the energy levels were reported to be low. The total number of participants was 15.

7.3.4 Class D

Class D is a general studies first grade high school class of age 16-17. The distribution between males and females is even. This group of participants totaled 25 people.

7.3.5 Class E

The final group of participants who participated in the evaluation was Class E. The class is a 10th grade middle school class, age 14-15 with an even distribution between males and females. They totaled 16 participants.

7.4 Process

The main evaluation was done in classrooms as a part of mandatory school activities, administered individually by the teachers of each class. The teachers were acquaintances of the authors and were recruited via e-mail, explaining this master thesis and why privacy awareness among teenagers is an important topic. 4 teachers participated in the evaluation of the game with a total of 104 students, spanned across 5 school classes. The players

were allocated between 25-50 minutes to play the game and answer the questionnaire. The authors were not present at the location during testing, and were only monitoring the server logs to ensure the game didn't crash.

The students were given the URL (`http://privacity.herokuapp.com/`) to the game from the teacher. They played individually on their own laptop, and as they reached the final level of the game they were given a unique ID and a link to the post-game questionnaire. Playing the game was a mandatory classroom activity, but answering the post-game questionnaire was voluntary (though encouraged). They were informed that no personal data is collected during the game session and that the data from the questionnaire is anonymous and confidential. Since the game was played individually, people finished the game at different times, and the students who finished were then given other tasks to complete (not related to PrivaCity).

Prior to the testing, the teachers received no information about cooperation between the students. This was because the researchers neither want to suggest it nor forbid it - and rather let it happen naturally. The teachers were instructed that if some players were unable to finish the game within their time frame, they could enter a command to jump to the end and do the questionnaire. However, this command was only used by one student, partly explaining why only 70 out of 104 participants reached the end-game summary. When doing an activity in a school class it is difficult to get all participants to do what you want, which can be another contributing factor to why only 70 participants finished the game. Also since the game is played individually, it is difficult for the teacher/administrator to know whether the students are doing what they are supposed to, or something else entirely. Errors from the game is not an explanation for the 34 participants who did not finish, as it never crashed and behaved as expected.

After the class, the teacher or administrator present during the evaluation was contacted via e-mail. They answered a few questions about how the session went. These questions were:

- How many students participated?
- Did the students cooperate to help each other?
- Did the teacher intervene during the game?
- How was the general atmosphere of the students? Did they seem to enjoy playing the game?
- Did you make any other observations? Did any problems occur?

Class A did the evaluation of the game as part of their English class as a fun activity where the students could use the chatbot to improve their written English language skills. The administrator present was a substitute teacher.

Class B is a class who did the evaluation without informing the authors. It is therefore difficult to know the exact circumstances around the evaluation, and the teacher did not answer the questions after the session. The participants were given a short amount of time to play the game.

Class C did the game evaluation as a part of "klassens time"; a designated class during the week where the teacher can inform of the administrative agenda without a curriculum. The game was intended as a fun and novel activity for the students who are celebrating graduation and preparing for exams. This game session did not go well, however. The

participants were allowed a very short time to complete the game, and few of the students had laptops to play it on. They attempted to use phones, but on the ”web-chat” platform PrivaCity is not optimized for mobile screens, and very few people were able to complete the game in the designated time. Only 2 out of 15 participants actually finished it.

The evaluation by Class D was performed by the same teacher as Class C and was also a part of ”klassens time”. This time the game session went a lot better, as all the participants had laptops to play the game.

Class E is another group of participants who evaluated the game without informing the authors. It is therefore difficult to know the circumstances around the evaluation. It appears however that the game session went well, and that the participants had sufficient time to complete the game.

The main data collection methods are the post-game questionnaire (presented in section 6.3.1), game session statistics (path chosen, time spent, etc.) and e-mail interviews with the teachers after the ended class activity. Since the authors were not present during the evaluations, little qualitative data was generated except second-hand observations from the teachers. Therefore the quantitative data (questionnaire and game statistics) is considered more important than the qualitative data in the main evaluation.

7.5 Results

This section will present the results obtained through statistics from the game sessions, post-game questionnaire and observations made by the teachers administrating the game sessions.

7.5.1 Game Session Statistics

The results from the game sessions show that out of the 104 participants, 70 finished the game by reaching the final level. This is presented in Figure 7.2.

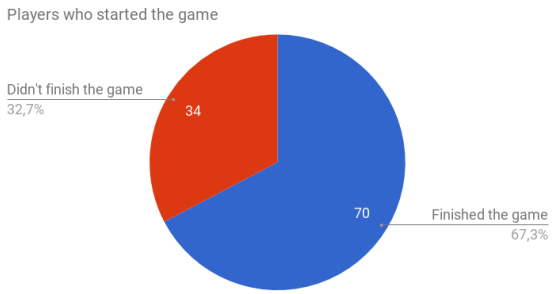

Figure 7.2: Showing how many of the participants finished the game.

In Figure 7.3 it is shown how long it takes to finish the game. The results show that the distribution between the two paths of the game is quite even, with 33 participants choosing to play the sneaky path, and 37 playing infiltration (out of the 70 participants who finished

the game). For the sneaky path, the average time to complete the game is 27 minutes, whereas for the infiltration path the average is 23 minutes.

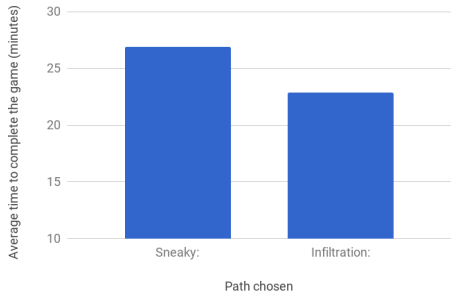

Figure 7.3: Average time spent to complete the game, depending on which path chosen in the game.

In level 3 of the game, the players have to finish a quiz about privacy in order to progress the game. The full list of available quiz questions and answers is available in Appendix D.1. In Figure 7.4 the questions where the players have answered incorrectly most times. The question which by far has the most incorrect answers is ”Does Facebook know which other web pages you visit?”. The incorrect answers are that the participants believe either that this is illegal, or that Facebook know *all* other web-pages you visit. The correct answer is that this is done with cookies through a ”like” or ”share” button on the web-page.[2]

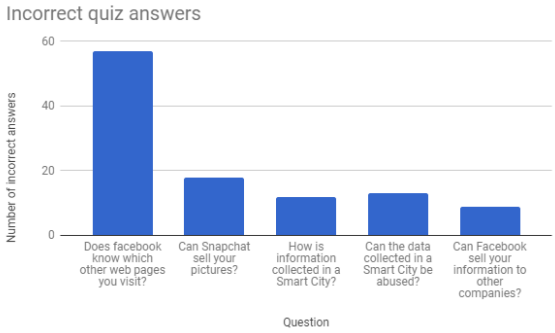

Figure 7.4: Quiz questions with the most incorrect answers.

7.5.2 Questionnaire Results

The post-game questionnaire gives more insight into the specific aspects of the game, such as the levels and if the privacy awareness of the players was raised from playing it. Out of

[2] *You Probably Don't Know All the Ways Facebook Tracks You* (2018). `https://fieldguide.gizmodo.com/all-the-ways-facebook-tracks-you-that-you-might-not-kno-1795604150`. (Visited on May 19, 2018).

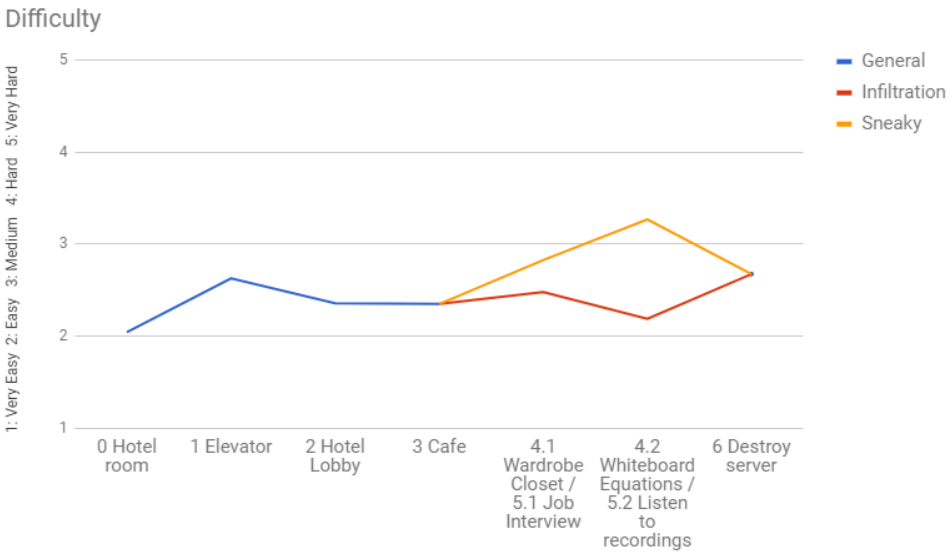

Figure 7.5: How difficult each of the game levels are. From 1: Very easy to 5: Very hard.

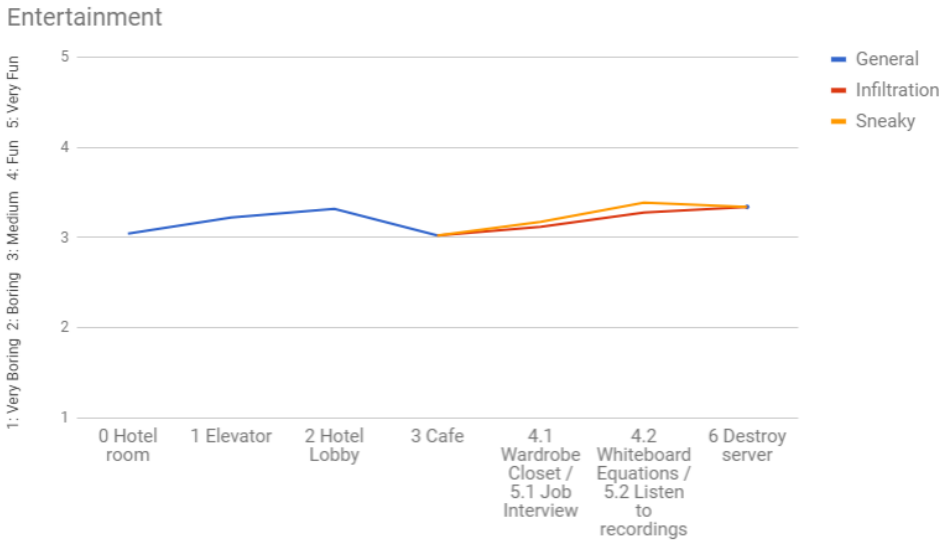

Figure 7.6: How entertaining each of the game levels are. From 1: Very boring to 5: Very fun.

Table 7.2: Reported learning outcome for participants in the main evaluation on a scale from 1 (Disagree) to 5 (Agree).

Statement	**Mean** *(n=45)*
I have learned something about privacy in Smart Cities	3,5
I feel more aware towards privacy in general	3,3
I will change my behaviour towards privacy	3,0

the 70 participants that finished the game, 45 filled in the voluntary questionnaire.

Game Levels

Figure 7.5 shows the graph of how difficult the different levels of the game are. In the sneaky path of the game, there is a gradual increase of difficulty as the game progresses, whereas for the infiltration path the difficulty is constantly around 2 (Easy) to 3 (Medium).

Figure 7.6 shows how the participants have evaluated the entertainment value of each game level. The results show that the levels consistently score between 3 (Medium) and 4 (Fun). There is little difference in the entertainment of the two paths of the game, but sneaky scores slightly higher.

Raised Awareness

To evaluate if the game raised the privacy awareness of the players, the questionnaire included three 5-point scale questions where the player would report his agreement from Disagree (1) to Agree (5). The average scores reported in the 1-5 point statements are shown in Table 7.2.

Respondents scored higher on the questions regarding learning outcome and raised awareness as compared to whether they would change their behavior. When studying the data grouped by educational stage (Ungdomsskole and VGS) shown in Figure 7.7 there is a significant difference across all three statements, with VGS scoring between 0.5 (p=0.2360) and 1.1 (p=0,0133) points higher. This shows that VGS students, who are older and have more education, have a bigger learning outcome from playing the game.

Another question asked the player to state how many hours he played video games per week. When grouping the same statements about learning outcome, raised awareness and behavior change there is also here a clear difference in what the players report. Figure 7.8 shows that players who spend more time playing video games report significantly lower scores on all three questions in comparison to players with little video game time per week. This means that players who play less video games have a bigger learning outcome from the game than those who play many hours of video games per week.

The participants were asked to identify the game elements they believe to have helped raise their privacy awareness. The results are shown in Figure 7.9. The game element which is believed to raise the awareness of the players the most is ”Quiz”, with over 50% of the respondents selecting it. The second most popular game element considered to raise

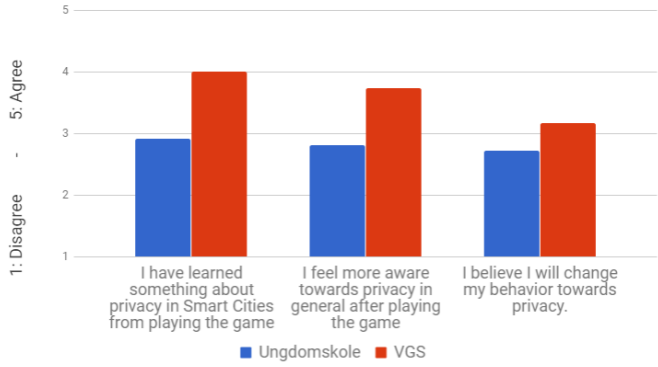

Figure 7.7: Reported learning outcome grouped by education stage (Ungdomsskole and VGS).

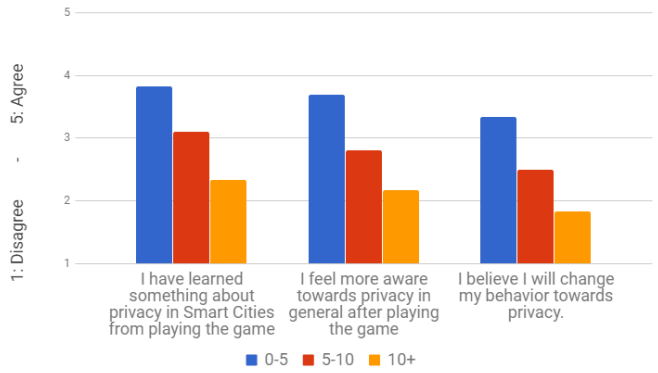

Figure 7.8: Reported learning outcome grouped by hours spent playing video games per week.

awareness is ”Real life examples”, with ”Consequences of actions” in third place. These three game elements stand out from the rest.

7.5.3 Teacher Observations

In addition to data gathered through the game and the questionnaire, the teachers that were present during the testing were asked a set of questions after the session (as explained in section 7.4). Not all the teachers answered our email. The teacher of class C & D (VGS) reported that the game got a mixed reception. Some of the participants thought the game to be difficult and subsequently gave up, while others enjoyed it, saying it was a ”brilliant” game. The students who seemed to enjoy the game were what the teacher called the ”stronger students”, i.e. the students who usually perform well.

> **Teacher of class C&D:** *”The game is a bit challenging for the students, but when they really concentrate it seems to be very good.”*

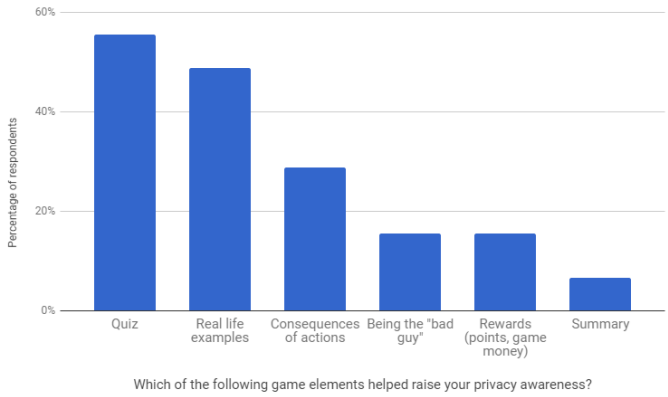

Figure 7.9: Learning elements in the game that is perceived to raise the privacy awareness of the player.

The teachers reported that some students cooperated; occasionally to understand the English wording, and sometimes to help each other progress in the game. The researchers who monitored the sessions remotely did notice a similar pattern in class E when multiple students were struggling with level 4.2. As soon as one student solved the puzzle, it was not long until the 4 other students quickly followed. The teachers said that the students needed no help from his/her part.

The teacher of class A (Ungdomsskole) reported that some participants did not think that PrivaCity should be called a game. When asked if they thought they had learned anything about internet etiquette, they responded no, but added that they got to practice their English. Some students also enjoyed that the bot responded back to casual conversation in an entertaining manner, i.e. ”small talk”.

7.6 Discussion

This section will discuss the results obtained in the main evaluation. What will be discussed is the learning and engagement game elements which have worked well, the raised privacy awareness from playing the game, the difficulty and target group of the game, and finally proposed changes as part of the future work.

7.6.1 Learning Elements

In PrivaCity a set of learning elements have been identified for each of the levels of the game. This is described in the game design in section 4.1.4, and the mapping between learning elements and levels can be seen in Table 4.2. In addition to this mapping, the participants evaluated which game elements they believed to help raise their privacy awareness. This was shown in Figure 7.9. By combining this information we can see which learning game elements can be considered to work well in a chatbot serious game designed to raise the awareness of the player.

According to the players **Quiz** is the game element which helped raise their privacy awareness the most. This is maybe not very surprising, as a quiz is a very direct way to teach something to the player. The general idea behind a quiz works well in a chatbot game, where the dialog goes back and forth between the bot asking questions, player responding, and the bot revealing the correct answer. It is also a game element that was used by several games studied in the literature review (Chapter 3). As we discovered in the pilot test, it is important to provide an explanation for the correct quiz answer. In doing so, one can also provide information to the player during the game.

The second most popular learning element is **Real life examples**. When providing information to the player, it seems that examples from the real world are much more intriguing and educational than general theory. This can be combined in a nice way with the quiz game element, where when explaining the correct answer one can use an example from real life.

Consequences of actions is something that was used as a foundation when designing PrivaCity. The players also believe that this is a good way to learn something and get raised awareness. It is however very important that the player actually gets to see how his actions impacted the game, which is the foundation for Consequential Play (explained in section 3.2.3).

The results of this main evaluation are mainly based on quantitative data generated when the participants played the game and answered the post-game questionnaires. By combining this data with the data from the pilot test, where the focus was on qualitative data through interviews and observations, we can get a good triangulation of data to determine the learning elements which work well in PrivaCity. The three learning elements considered most helpful to raise awareness in the main evaluation (quiz, real-life examples, and consequences), were also among the top scoring learning elements in the Pilot Test (Chapter 6). We can therefore determine that these are the game elements which work best to raise the privacy awareness of the players in PrivaCity. However, this does not mean that the other learning elements do not work well in a chatbot serious game. These results are in the isolated case of PrivaCity. And even though the game was designed to explore which game elements work well in a chatbot serious game, some aspects of the game may have been designed and developed better than others.

7.6.2 Engagement Elements

To determine which game elements work best to engage the players we can look at Figure 7.6 which shows how entertaining each of the game levels have been rated by the participants. In a similar way to the learning elements, each level of the game PrivaCity is mapped to a set of engagement elements. This mapping can be seen in Table 4.3.

The level which scores highest on entertainment value is Level 4.2 of the sneaky path. This level of the game is designed with a focus more on entertainment than on learning outcome, and doesn't have a primary learning goal connected to it. It seems therefore that the participants prefer the levels with a focus on entertainment rather than education. This is not very surprising. Level 4.2 only has one engagement element connected to it; **Curiosity**. This supports the findings in the pilot test which suggested that it is often more beneficial to focus on a low number of game elements in the levels of a game, and concentrate on doing them well. Curiosity is an engagement element which is used in

many levels of PrivaCity, where some score high on entertainment value, and others don't. Yet curiosity is an engagement game element that seems to work well in chatbot games.

As explained in section 4.1.4, curiosity is a typical intrinsic motivation. Intrinsic motivation involves engaging in a behavior because it is personally rewarding; essentially, performing an activity for its own sake rather than the desire for some external reward (Cherry 2018). In PrivaCity the engagement elements with intrinsic motivation seem to be more entertaining than the ones with extrinsic motivation (rewards, points, etc...).

Consequences of actions which many of the players rated to work well as a learning element is also a great way to engage the player. The levels where the player sees and feels that his actions have consequences for the story and narrative of the game consistently score high in entertainment value.

Difficulty

One of the big factors when it comes to entertainment in a game is the *difficulty*. This is connected to the theory of flow where it is often desirable to gradually increase the difficulty of the game to keep the player interested, and not bored. By examining Figure 7.5 we can see that on the sneaky path of the game there is a gradual increase of difficulty. The infiltration path is not rated as difficult, and is possibly considered too easy by many players. The most difficult level of the game, level 4.2, is also considered the most entertaining one. This might indicate that increasing the overall difficulty of the game will increase the entertainment value. This is supported by one of the changes made to the game between the pilot test and main evaluation. Due to changing chat platform from Facebook to WebChat, adjustments were made to Level 1 - making it more difficult to solve the password to the elevator (as explained in section 7.1). This resulted in an increased entertainment value for the level from 3 (Medium) in the pilot test to 3,22 (Medium to Fun).

While an overall increased difficulty of the game might seem to make it more entertaining, the observations from the teachers who were present during the testing indicate that the game was more than challenging enough for several students. It is desirable that the game is playable for everyone, not just the "strongest students" as the teacher decided to put it. Therefore an increased difficulty would probably have led to even fewer students being able to finish the game.

7.6.3 Raised Privacy Awareness

PrivaCity is a game created to make teenagers more aware of privacy risks in Smart Cities and related privacy topics. Table 7.2 gives an overall representation of whether the participants learned something, had their awareness raised and will change their behavior towards privacy. The numbers show that the game did best in teaching the participants about privacy and raising their awareness while promoting behavior change was less successful. This is consistent with multiple studies that discuss the difficulties of achieving behavioral change with a serious game (Blythe and Coventry 2012; Vanderhoven 2014; Martens 2010; Mishna et al. 2011). It is important to note that the evaluation of learning, raised awareness, and behavioral change is just the participant's perception in the form of a questionnaire response and not an evaluation of their actual learning outcome.

Figure 7.7 presented the difference when answers are grouped by education stage (Ungdomsskole and VGS). VGS students report a significantly higher learning outcome than that of Ungdomsskole students. The same can be said for raised awareness where VGS students once again report a much higher score. Behavior change on the other hand, see a less significant difference as students from both educational stages report a lower score (3,2 vs 2,7). PrivaCity is a game developed to target VGS students which might explain the differences. The game is played in English, and it is reasonable to assume that the language expertise is higher with the students who have more education, regarding both reading and writing skills. Observations made while monitoring the sessions together with game data supports this, as there were a lot more misinterpreted utterances when the game was played by an Ungdomsskole in comparison to VGS. Ungdomsskole students often struggled with wording and spelling, leading to the bot not being able to interpret the commands. Another reason might be that older students are more mature and willing to learn. One should also take into account that the learning elements implemented in PrivaCity were intended for VGS students, and that other learning elements might be more suited for students at the Ungdomsskole level.

In a similar way to the difference between Ungdomsskole students and VGS students, there was a big difference when grouping the responses by time spent playing video games per week, as seen in Figure 7.8. The figure presents a clear trend showing that students who spend more time playing video games are less receptive to the learning goals of the game. This holds true for all three questions, where the students report lower learning, awareness, and behavior change. One possible reason for this lower learning outcome for ”gamers” might be that they bring higher expectations to the game, and approach PrivaCity as if it was a regular game and not the serious game it is. In the evaluation of a serious game, Dickey (2011) discusses two participants considering themselves gamers. Instead of playing the game as intended, they spent their time attempting to deconstruct the game environment as they approached the game the same way they would any other game. This is similar to one ”gamer” participant (20+ h/week) in the testing of PrivaCity that was able to make his game session freeze by interrupting the chatbot too many times. The same player commented that the game ”still had a few bugs to iron out” and provided suggestions that he thought could improve the game experience. This shows that he might have been more focused on the playing aspect of the serious game than the learning objective. In comparison, another participant which is not considered a ”gamer” (0-1 h/week), stated that PrivaCity was a: ”Great game, made me think about how much information the companies Facebook, Snapchat and others knows about me and how they can use it”. This feedback is very different from that of the gamer, focusing more on the educational part of the game. These results might suggest that non-gamers are more receptive to learning through games as they care less about the actual game itself, but more about the underlying learning. At least that seems to be the case in PrivaCity.

7.6.4 Proposed Changes

According to the findings in the main evaluations, some changes are proposed that can be made to the game PrivaCity.

One of the main issues with the game is that while it works well for a broad section of users, it isn’t considered a great way to learn about privacy concerns by *all* the participants

who played it. People want different things from a game, learn in different ways and are engaged by different game elements. A way to solve this is to adapt the game more to the specific player who is playing. For people who play a lot of video games, PrivaCity is considered too easy - therefore the difficulty should be higher for those players. Some players find the language too difficult - for those players the language and word usage should be simpler. Some players prefer to only use buttons to interact with the bot - they should have the option to do so. While these changes are definitely possible to implement, it will require a big development cost. One has to consider if it is worth the effort to include said adaptions, or if it is better spent elsewhere.

It is shown that older teenagers who have a better understanding of the English language (VGS students) have a higher learning outcome of the game. A possible way to include the younger teenagers is to make an adaption of the game in their native language Norwegian. The biggest challenge is the natural language processing (NLP) service. Language processing is much more mature for the English language, and few services support Norwegian. However, it is possible to train a service to understand Norwegian words and match them to intents. For anyone wishing to target young teenagers with a chatbot serious game, we recommend making it in their native language.

In order to help the player advance the game, the PrivaCity chatbot gives the player some hints on what actions are available in the current level when it doesn't understand what he meant. Nonetheless, many players got stuck in certain levels, weren't able to progress and gave up finishing the game. Before giving up it was observed that many players said things like ”help”, ”what should I do?”. One way to ensure that more people are able to finish the game is to provide even better hints when the player admits to giving up in a certain level. This will remove some of the challenge connected to having to complete the task in each level, but will ensure a higher percentage of players being able to complete the game.

Chapter 8

Guidelines for Chatbot Serious Games

This chapter will present several guidelines for designing and developing chatbot serious games. The topics to be presented are which engagement and learning game elements are well suited for a chatbot to raise privacy awareness, how to interact with the player, and finally considerations for the developer.

These guidelines are based on the findings made in the literature review (Chapter 3), design and development of PrivaCity (Chapters 4, 5), and the game evaluations in the pilot test (Chapter 6) and the main evaluation (Chapter 7).

The guidelines are a direct response to, and help answer, the main research question of this thesis: **RQ1**: ”How can chatbots be used in adventure-based serious games to raise awareness for data privacy risks?”. Some of the guidelines presented in the chapter are specific for chatbot serious games for privacy awareness - especially the engagement and learning game elements used to raise the privacy awareness of the player. Whereas other guidelines are more general, like guidelines on how to interact with the player in a chatbot game. We believe they can and should be employed to any chatbot serious game which aims to raise the awareness of the player on a certain topic, like privacy awareness.

8.1 Game Elements

All games consist of one or more game elements. Engagement elements are elements to engage and entertain the player, whereas learning elements are aimed at teaching, raising awareness or changing the behavior of the player. In this section, the guidelines for game elements in chatbot serious games is presented. The desired learning outcome of PrivaCity is to raise privacy awareness, but many of the same principles apply when designing a chatbot serious game with another desired learning outcome than raised awareness.

Limit the number of game elements connected to each level of the game.

The results indicate that it may be more effective, both in terms of engagement and learning, to choose a few game elements and do them well. In PrivaCity, the different levels of the game have different game elements connected to them (see Tables 4.2, 4.3). The levels we consider most successful have a limited number of game elements connected to them.

8.1.1 Engagement

Start easy and increase the difficulty as the game progresses.

Interacting with a chatbot is a new experience for a lot of people. It is therefore important that the first level of the game is one with a simple goal, where the player can get comfortable with the chatbot interaction. When the player has become comfortable with the chatbot, the difficulty of the game should be increased gradually, and the player can be introduced to more complex privacy concepts. This is in line with the theory of flow (explained in section 2.6.1). Difficult tasks and levels may be more frustrating as they are carried out, but once completed leaves the player feeling more entertained and with a sense of achievement.

Force the player to be curious and to explore the game.

The most entertain parts of a chatbot game are the levels where the player feels free to explore the game. To progress the game he might need to find clues hidden in the room and connect pieces of information about privacy in smart cities. Many players are very goal-oriented, and given the opportunity to jump to the next level will do so without exploring the current one. If you want curiosity to be an engagement element of your game, it should be used as a mean to progress the game - not just an optional side-path.

Let the player know and feel the consequences of his actions.

To have the actions of the player shape the story of the game is a good way to both engage and learn, as explained by the theory of consequential play (see section 3.2.3). However, the player needs to be made aware of the impact he has on the game world. Simply altering the story without telling the player has no impact on the engagement level. The player needs to know that the story was changed because of his actions, and refer back to decisions made earlier in the game. A chatbot is conversationally driven, and this impact must be made with text as a part of the narrative, rather than through visual aids (like in a normal 3D computer game).

8.1.2 Learning

Quiz is a great way to convey knowledge about privacy in a chatbot game.

The results show that Quiz is considered a good learning element for serious game chatbots. The logic behind a quiz is simple and suits well for a chatbot where the dialog goes back and forth between the bot asking questions, player responding, and the bot revealing the correct answer. It isn't a game element which directly raises the privacy awareness of

the player, but teaches him about privacy concepts. The privacy conceptualization ”Privacy Calculus” (see section 2.1.4) is about the privacy trade-offs everybody makes when deciding what to share or not to share. By learning privacy concepts from a quiz the player will be more informed about how information can be used, and can therefore weigh the trade-off better. Thus having a raised awareness.

> *Provide an explanation for the correct quiz answer. Even if the player answers correctly.*

When using a quiz as a learning element in PrivaCity, we have experienced that what the player actually learns from is the explanation. Therefore, the chatbot should provide an explanation of what is the correct answer, and why it is so - regardless of whether the player responded correctly or not.

> *Use real life examples when providing information.*

Providing information is not as much a game element as it is a traditional learning element. Therefore, to make it more engaging and interesting to the player, we recommend using privacy issues from real-life examples. An example from PrivaCity is telling the player about the doll Cayla[1] when he is going to classify recordings that the rulers have gotten access to. This provoked observable reactions with the players, making a bigger impression than just presenting the information without an example.

> *In-game consequences can teach the player about real-life privacy consequences.*

As explained above, consequences of actions is a great way to engage the player. In a game about privacy awareness, it is important to have the player understand that all privacy decisions are a trade-off and that the choice made has consequences for his future privacy. This trade-off is the foundation of ”Privacy Calculus”. Therefore the game element of having consequences of actions in the chatbot serious game directly translates to real life, which is where we want to raise the privacy awareness of the player.

8.2 Interacting With the Player

As mentioned above, using a chatbot to play a game is something that is new to most people. For a website or desktop application where the user uses mouse and keyboard to interact with the game, he expects it to act in a certain way. That is because he has already interacted with hundreds or thousands of similar applications, and there are clear protocols for how the application *interacts* with the user. With a chatbot, things are different. Our results show that people have interacted with chatbots ”a few times”, and that they do so in widely different ways. Some people prefer to use simple buttons, and others to interact by text. Some people by full sentences, and others by a single word, i.e. ”open”. For a

[1] *Forbrukerrådet: Du kan bli avlyttet gjennom disse lekene* (2016). `http://e24.no/digital/personvern/forbrukerraadet-du-kan-bli-avlyttet-gjennom-disse-lekene/23865399`. (Visited on Feb. 14, 2018).

chatbot game to be successful it is crucial to accommodate for all of these different player types, and strive towards meeting their expectations. This section will provide guidelines for how the chatbot game should interact with the player, and is especially relevant for chatbot adventure games.

Provide a chatbot typing animation.

Norman (2013) introduced several interface design principles that are widely regarded as critical for successful and high usability interfaces. One of these principles is feedback, and how a system should provide the player with a response when he performs an action. Both successful and unsuccessful actions should have feedback, so not to leave him wondering whether his action was registered. This concept is also valid for a chatbot game and can be implemented by adding a typing animation from the bot after the player sends a message. The bot is attempting to resemble a person chatting, which on most chat platforms will present a typing indicator to the other person when typing a message. This is also in line with the principle of consistency (Norman 2013), and the player can apply existing pattern knowledge to the chatbot game.

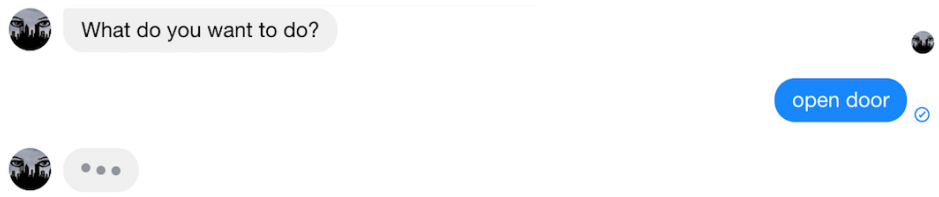

Figure 8.1: The typing animation lets the player know that the bot has received the message and is creating a response.

Handle messages that cannot be interpreted by giving hints on what the player can do in the current level.

Another guideline related to the principle of feedback is what the bot should do if it receives a message it is unable to interpret. In addition to providing a typing animation, the bot must respond to the message received. If said message cannot be interpreted, it is still very important to give a meaningful response. A way to solve this, which was successfully implemented in PrivaCity, is to give a brief explanation that the bot did not understand the message - and subsequently present the player with buttons showcasing the different actions the player can perform in the current level. By presenting the player with buttons after he typed a message that ”failed”, the game ensures that he is successful in his next attempt at interacting with the chatbot, preventing frustration and further failure. Additionally, this helps progress the game for the player.

Implement an appropriate mix of text and buttons.

We mentioned that buttons can be utilized to simplify the player experience. In more traditional customer service chatbots, buttons can often be preferred as the more suitable option

as it is an easy way to simplify the experience. In a chatbot game, using only buttons can make the game a simple and boring experience. It may also hinder the curiosity of the player, which is crucial in an adventure game. We therefore suggest using an appropriate mixture of text prompts and buttons in order to aid players who struggle, while still preserving the curiosity aspect in exploring the virtual world with text.

Send multiple messages rather than one long.

In some sections of the game, like in the introduction, it might be necessary to present large amounts of text to the player. Receiving a long message can be overwhelming for the player, and these messages should instead be divided into multiple messages, separated by typing animations and suitable pauses This allows the player sufficient time to read. The principle of consistency is again relevant, as it should strive towards resembling an interaction with another human.

Utilize emojis in a way that aids the player.

Another aspect that was successfully implemented into the game was the use of emojis by the chatbot. Emojis were mainly used in two different ways: As a way of illustrating who's talking to the player, and to clarify which objects the player can interact with. Test users said that the emojis helped break up long sections of text, but more importantly helped clarify which objects they could interact with in the game.

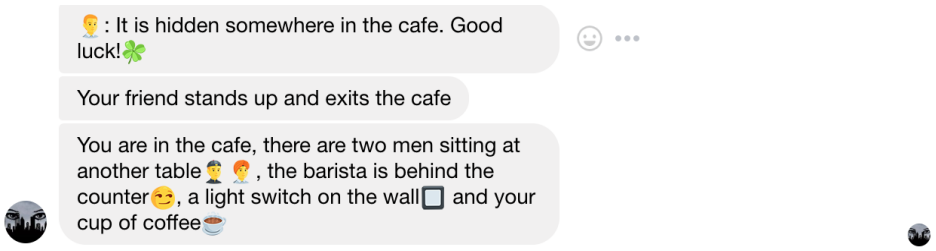

Figure 8.2: Using emojis can show the player who is talking, and clarify interactable objects.

Build user trust early to ensure exploration.

A recurring observation in testing was how interactions early in the game played a vital role in how the player was able to progress later in the game. Players who get their first couple of messages misinterpreted by the bot, seem to lose confidence in the bot and become hesitant to explore freely in later stages. Early stages of the game should therefore include fail-safe tasks and message interpretation, in order to build user trust. This will lead to the player being more confident to explore the game in later levels.

8.3 Development Guidelines

The technical description of PrivaCity can be seen in Chapter 5. The most essential technologies used to develop the game is Microsoft Bot Framework, Microsoft LUIS for lan-

guage understanding, and Facebook Messenger and Web-Chat as chat-platforms. This section will provide guidelines for the development of chatbot serious games.

> *Divide the levels of the game into distinct dialogs which only handle the logic of that level.*

When developing a chatbot game, as with any game, it is important to structure the code base. In a chatbot SG, we recommend separating the levels of the game into different dialogs. This is because you want the logic to be different in distinct levels. The level dialog should only handle the logic of possible actions in that level, which ensures high cohesion in the system. The levels and dialogues should be loosely coupled, meaning that a level is functioning independently of the previous levels.

> *Create a "small talk" dialog which handles the response if the utterance of the player isn't linked to any action in the current level.*

To provide good functionality, the bot should be able to perform simple small-talk. This should not be handled in the different levels of the game, but rather in a centralized small talk dialog. We recommend the small talk to be independent of which level the player is situated and be of a generic nature. This is to not distract the player from the game itself.

> *Store utterances which do not map to a level action in order to train your language understanding service retrospectively.*

Whenever the chatbot has to resort to small talk, it means the player said something that has no connected functionality in that level. Storing these utterances lets them be used later to train the NLP service. That way the chatbot is always improving and will get "smarter" over time.

> *Log the conversation with the player.*

Another way to improve the functionality of the chatbot and avoid unwanted behavior is to log the conversations of the player. On the platform Facebook Messenger, this is done automatically, whereas on web-chat on a web page it must be implemented by the developer.

> *Create and store game statistics automatically upon an ended game.*

Upon finishing the game, statistics from the game session should be generated automatically. This is both for the player to see in an after-action review, but can also be analyzed later by the developer to improve the game.

> *Train NLP with a large dataset - many utterances from different sources. Including misspellings.*

Training an NLP is something that requires a large dataset before it becomes good at understanding natural language. When training the NLP, one has to think of all the ways a player can express a certain desire. For a single person, it is easy to get stuck on a single train of thought, and it can be beneficial to get a second or third opinion. Some of the previous guidelines are also in place to mitigate this challenge, like storing the "failed" utterances which are going to "small talk".

Chapter 9

Conclusions

A summary of the main contributions to the field of serious games for privacy awareness presented in this thesis is: the literature review of chatbot and serious games (Chapter 3), the design (Chapter 4), implementation (Chapter 5) and evaluation of the chatbot serious game PrivaCity (Chapter 6, 7), and as a result of the findings, engagement and learning elements, and a set of guidelines for chatbot serious games (Chapter 8) is presented. This can be utilized by anyone who wishes develop a chatbot serious game for privacy awareness or other scenarios.

9.1 Research Questions

In this section, we will look to answer the 4 research questions which are the foundations for the research made in this Master thesis.

> **RQ1**: How can chatbots be used in adventure-based serious games to raise awareness of data privacy risks?

The design, creation, and evaluation of the chatbot serious game PrivaCity are presented in the thesis. The game is an adventure game with the intention of making teenagers aware of privacy challenges in smart cities. After evaluating the game with 104 participants between age 13-18, results show that their awareness was raised to some degree after playing PrivaCity.

Perhaps more interesting are the results that show that older high school (age 16-18) students had significantly higher learning outcome, raised awareness, and slightly higher perceived behavior change from playing the game, as compared to younger teenagers (age 13-15). This might suggest that chatbot adventure based serious games are better suited for older teenagers, especially when the narrative is not in their native language.

Very similar results are shown when looking at hours playing video games per week instead of age. Students who play less video games report higher raised awareness from playing the game. This might imply that adventure chatbot serious games yield best results

when the player has less experience with computer games, and that the simple text-based interaction becomes too plain or straightforward for experienced ”gamers”.

In Chapter 8 a set of guidelines for chatbot serious games is presented. These are takeaways from the design, development, and evaluation of the game PrivaCity. They are a direct response to the main research question in this thesis and outlines exactly how adventure chatbot serious games can be used to raise awareness. In the case of PrivaCity, the issue to raise awareness about is privacy risks in a smart city, but the concepts will hold true for serious games focusing on other scenarios.

> **RQ1.1**: How can the game genre ”adventure” be used in chatbot serious games for privacy awareness?

In the related work, it was explored how narrative-based adventure has been used in existing serious games, and how it can and should be used. The findings were used as a foundation for the design of PrivaCity.

In an adventure chatbot serious game, the narrative of the story is very important since the game is conversationally driven. For the game to be successful, it is essential that the storyline should be closely connected to the learning outcome of the game. Creating a WW2 narrative in a chatbot serious game to raise awareness about global warming is not likely to maximize the potential learning outcome. Instead, locating the narrative of the game in the arctic or on a flooded island would be a better option. This holds true for PrivaCity, where the main storyline of the game is that the city council is planning to abuse private information collected in the smart city. A narrative theme related to the learning outcome can function as an important cognitive tool to organize material and hence boost the player's learning outcome (D. M. Adams et al. 2012).

Exploring a virtual world in an adventure game can be difficult with a chatbot, as the player needs to say the right things to progress the game. Therefore it is valuable to provide hints to the player which can aid him in the right direction. This scaffolding can help ensure that the player progresses through the game and does not get stuck in sections, skips it or abandons the game entirely. In PrivaCity, only 70 out of the 104 participants finished the game. The players received hints to advance the game, but maybe including even more and direct hints would have ensured that a larger number of players didn't abandon the game.

> **RQ1.2**: How can chatbot serious games engage the user?

To investigate how one can engage the user, in the related work this thesis identified several game elements that can be used to engage the user in a chatbot serious game. These elements were implemented into PrivaCity and later evaluated. As explained in section 2.6, what engages the player depends on what kind of user he is - some players are more motivated by exploring a world, whereas others are motivated by competition (Tondello et al. 2016).

Curiosity was an element used consistently in many of the levels of the game. Players enjoyed being able to explore freely, and to make choices. Therefore curiosity is a specific game element that chatbot serious games can use to engage the user. Another game element which is considered a good way to engage the player in a chatbot serious game is to let the player know and feel the consequences of his actions. Players enjoy feeling

like they shape the narrative and story of the game. Like in real life, actions should have consequences, and it is important that the player sees how his actions have changed the course of the game.

An interesting finding is how game levels with fewer elements are often more enjoyed and engaging compared to levels that implemented a bigger set of elements. This can indicate that it is better to use fewer game elements to engage the player and focus on doing them well, rather than using a bunch of engagement elements which might result in a less engaging game.

To have the right level of difficulty in the game is another way to engage the player. Some people have experience with chatbots, whereas others are interacting with one for the first time when playing the chatbot game. Findings show that it is therefore important to accommodate for both these types of players, setting the right difficulty in the game to not make it boring nor too difficult.

RQ1.3: How can chatbot serious games raise awareness?

In a similar fashion to engagement elements, the related work section in this thesis identifies elements that can be used to raise the awareness of the player. Just like there are many ways to engage the player in the game, there are many ways to enhance the learning outcome for the player. The game elements were evaluated by implementing them in PrivaCity in different sections of the game.

A game element that proved effective with the players of PrivaCity, was a quiz. To further increase the raised awareness from the game element, the chatbot should provide a brief explanation of the answer. Especially the explanations that contained real-life examples were considered successful. Even though quiz is a good game element to raise the awareness of the player, we don't believe an entire game based on a quiz is a good idea for a chatbot serious game. That would become too repetitive, and thus quiz is much better suited as a game element in a bigger adventure game.

Consequences of actions is one of the game elements that work well to engage the player. It is also a great way to raise the awareness of the player in a chatbot serious game. The players of PrivaCity found this to be a successful way to learn about how actions have consequences. This game element may be especially relevant in a serious game trying to raise privacy awareness, as one of the main concepts is to have the player understand that all privacy decisions are a trade-off and that the choice made has consequences for his future privacy. This trade-off is the foundation for the privacy conceptualization "Privacy Calculus" (see section 2.1.4).

9.2 Strengths and Limitations of the Work

A general strength of the research done in this thesis is the triangulation of data from several data collection tools. In the pilot testing of PrivaCity, the focus was to generate qualitative data which could be used to identify unwanted behavior, improve the game and begin evaluating engagement and learning aspects. This was done by observations and interviews. In the main evaluation, there was a high number of participants (n=104) in the target group who evaluated the game. This generated quantitative data through

questionnaires and statistics generated from the game itself. The data was used to evaluate the game and how it works as a tool to raise the awareness of teenagers. The data was triangulated from both the qualitative and quantitative data sources, which should improve the validity of the results presented in the thesis.

One of the weaknesses of the research conducted is the literature review in (chapter 3). We have called this a "Quasi-Systematic Literature Review". The method, search criterion, and data sources are presented as they should be in a systematic literature review, but the results from the search queries are not shown in full. Instead, the researchers included articles and publications based on their title and abstract relevance, citation count and recentness. In the report, only publications that were included and deemed relevant by the authors are presented. While it helped to position our work in the field of research, the method is not as rigorous at is could have been.

9.2.1 Game Elements and Game Design

One of the main focuses and contributions in this thesis has been the identification of engagement and learning game elements which work well in adventure-based chatbot serious games. These elements were implemented into the game PrivaCity and later evaluated. For the sake of research, it is assumed that all game elements are made equally well in PrivaCity, in order to be able to evaluate and compare them. In reality, this is probably not the case, as it is impossible to design and develop all aspects and levels of a game equally. Because of this, we deliberately chose to focus on the game elements which seemed to work well. The fact that they were successful in PrivaCity indicates that they can be effective in other chatbot serious games. We have purposely not focused on the game elements which doesn't seem to work well in the game PrivaCity, as the problem may be the design or implementation of said element - and not the fact that it doesn't work well in a chatbot serious game.

A point to discuss is whether the scenario of privacy in Smart Cities is something that is relevant to teenagers today. As discussed in the game design (Chapter 4) the scenario is chosen based on results from the co-design workshop user study presented in Appendix A. Even though smart cities was deemed one of the most popular scenarios, it is not something that teenagers deal with every day - at least in comparison to i.e. social media. It is however a topic that will become more and more relevant as data being collected by digital sensors is an ever growing privacy concern. Additionally, the results from the evaluations show that even if the focus of the game is on smart cities, the awareness around privacy in general is also increased from playing the game.

The target group of PrivaCity is teenagers. The research is based upon the workshop (presented in the paper in Appendix A) where the participants were Norwegian teenagers, and the participants who have participated in the main evaluation of the game are also Norwegian teenagers. Therefore, a limitation of the work is that the data the game has been based on and evaluated with has only been generated by Norwegian teenagers. It is only assumed that the game will work equally well for teenagers of other nationalities. The language of the game is in English, and as explained in section 5.4 this is because of technical limitations. It is reasonable to believe that the learning outcome would have been higher if the chatbot serious game was in the native language of the player - in this case Norwegian. Especially the results which show that older teenagers have a higher

raised awareness from playing the game support this assumption. This may be because they understand and speak English better than their younger counterpart.

9.2.2 Discussion of Data Collection Tools

Questionnaire

The questionnaire was iteratively designed in the pilot testing to ensure it was able to gather the data needed to evaluate the different aspects of PrivaCity. It worked as a suitable tool to gather large amounts of structured data from participants when the researchers were not present. The questionnaire, containing mostly pre-defined answers are easy to both solve for the respondents and later analyze for the researchers.

A challenge related to the questionnaire is that the questions may bias respondents to the researcher's way of seeing things. The researchers are also unable to correct misunderstandings, follow-up to get more detail or provide explanations or help. With large amounts of data, there is also the risk of human error, both systematic and random, either from the respondent themselves or later by the researchers when accumulating the data. Another problem with the questionnaire, and particularly the Likert scale questions (Likert 1932), is that some users are impatient and answer at random, or only choose extreme answers. This was seen in some responses where all answers were 1's or 5's. There is no way for the researchers to know whether this is their genuine response, or just fast clicking to finish fast.

The questionnaire was sent as a link in a message from the chatbot once the player finished the game. This required the player to notice and enter the link and answer the questionnaire. A problem related to this was that players that did not finish the game, were unable to access the questionnaire. This was partly solved by giving the teachers a game command that once entered by the participants, finished the game and allowed them to access the questionnaire without completing the game. It may have been better to distribute the questionnaire in another way to increase the response rate.

Observations

Observations, as opposed to questionnaires, provide important data about what the participants actually do, and not just what they say they do. A challenge with using observations as a data collection method is the validity of the data, as researchers often have selective memory and perception (Oates 2005), and may be biased by their assumptions and preconceptions in their observations. To strengthen the claim to validity and get a broader and deeper understanding, two researchers, acting as complete observers (Oates 2005), made independent observations without interfering in all user tests and later compared their findings as a way of investigator triangulation (Guion 2002). Data obtained through observations was also triangulated against data collected in the interviews and questionnaire. Additionally, audio recordings supplied the data with verbatim quotations, to ensure the actual wordings of the participants were recorded, and not just the researcher's summary.

Interview

Interviews were used throughout the evaluation of PrivaCity in different ways. In the pilot, unstructured interviews were used after the game session as a way to let the participants freely speak their mind about the game without being constrained by a set of questions. A disadvantage related to the unstructured interview is that the researchers were running the interviews, which might challenge reliability as full objectivity is hard to achieve. Researchers may lead the interviewee in a desired direction.

For the final pilot test, there were three simultaneous participants, and the researchers decided on a group interview to save the time of both parties. An advantage of doing group interviews is that the group can stimulate each other into coming up with new ideas and discussions, as one participant's views might be challenged bringing other group members into play. The group interview can also provide the possibility of obtaining consensus views, but can at the same time see some members dominate the talk preventing quieter participants from bringing unpopular opinions to the table. Having the players do the questionnaire beforehand was therefore important in order to let them speak their mind prior to being influenced by other participants.

The final interview type used in this project was an email interview with the teachers that facilitated the sessions in their class in the main evaluation. The asynchronous interview style is practical, time efficient and was a favorable substitute as the teachers were located in other parts of the country (Burns 2010). These interviews were done in a structured manner by sending a set of questions. A limitation regarding email interviews is that the questions are answered when the teacher has time, which may not be straight after the session, but later when observations and impressions may be forgotten. The researchers chose not to send any follow-up questions.

Game data

Storing of data from each game session was a valuable approach for both improving the game itself as well as gathering data about the players. By storing all utterances from the player that was not interpreted by the bot, it was easy to train the language processing so that it would understand it the next time. Data was also stored to track which quiz questions were answered incorrectly the most, how much time each player spent and how many players started the game without finishing.

A difficulty with storing game data is choosing which data to log. Do you want everything, or just the most vital parts? Opting to store everything can create vast and overwhelming amounts of data, while storing too little can result in incomplete information. That being said, the game data gathered is perfectly unbiased and can give hard facts without the need for extensive interpretation.

9.3 Recommendations for Future Work

There are several things that can be considered future work from this Master thesis. After completing the main evaluation, a set of proposed changed was presented in section 7.6.4. They were identified as a consequence of some of the weaknesses showed during the

evaluation of PrivaCity. The proposed changes focus on making the game adapt more to the different types of players of the game, in order to make it better for all types of users and players. Implementing the changes could help solve some of the problems highlighted, such as the lower learning outcome for young teenagers and students who already play a lot of games.

The results of this thesis, especially from the data gathered in the questionnaire, are based on what the participants say that they have learned from playing PrivaCity. A part of the future work is to actually evaluate if the players know more about privacy risks after playing the game. This should be done by measuring the knowledge or awareness before and after a game session with a pre-test and post-test.

As discussed in Chapter 2, there exists many privacy issues which require attention. PrivaCity is an example of *one* scenario; privacy issues in smart cities. In section 2.4 a set of other privacy scenarios in need of focus is discussed. Therefore the most important future work is to continue raising awareness around privacy issues, be it with serious games or by other means. Should anyone decide to use a chatbot serious game to focus on raising privacy awareness for other scenarios, this thesis and the guidelines presented in Chapter 8 are a good place to start.

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Appendix A

Paper: Supporting co-design of games for privacy awareness

The following paper has been submitted for International Conference on Entertainment Computing (IFIP-ICEC'18)[1], awaiting review.

[1] *International Conference on Entertainment Computing (IFIP-ICEC'18) - POZNAN, POLAND, SEPTEMBER, 17-20TH, 2018* (2018). http://www.ifip-icec.org/. (Visited on May 30, 2018).

Supporting the co-design of games for privacy awareness

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Abstract. Privacy is a well-known concern connected to teenagers´ usage of e.g., social media, mobile apps, and wearables. Games have recently been proposed as a tool to increase awareness of privacy concerns. It is however important that these games are relevant and engaging. In this paper, we present a workshop to involve teenagers in the co-design of games to promote privacy awareness, describing the workshop process together with the cards and the board that support the process. We evaluated the workshop together with students between 15-17 years of age divided in groups of 3-4 participants. Results show that all the groups were able to generate interesting game ideas and the workshop was perceived as entertaining. Drawing on observations and participant feedbacks, we reflect on the strengths and limitations of the workshop.

Keywords: Co-design, Game design, Privacy Awareness games.

1 Introduction

Privacy is an ever-growing concern. With the technological development and increase in use of connected devices, data is being collected everywhere. Terms of service are complicated, leaving people unaware of what type of data they share, with whom and what it is used for [17]. The new General Data Protection Regulation (GDPR) in Europe, in effect May 2018, addresses some of these concerns, but individuals still have to be aware of privacy issues and act accordingly in a rather complex context [4].

Teenagers are a user group for which concerns are higher. They are heavy users of digital services and might lack knowledge about data sharing and underestimate the risks. For example, a study conducted by NorSIS [14] shows that only 28,4% of Norwegian youth received training in information security in the last two years.

Serious games have recently emerged as a way for children to learn about sharing of personal data and privacy in an engaging and evoking way. Just to mention a few examples of privacy related serious games (hereafter simply games):

- *Friend Inspector*, described in [3], is a game that aims to raise the privacy awareness of Social Network Sites (SNS) users, like Facebook. The conceptual design of the game focuses on the discrepancies between perceived and actual visibility of shared items. It is a memory-like game where the player is asked to guess the visibility of an item. To give the user a relevant context, the frame story is based around items shared on the user's own profile.

- *Master F.I.N.D.*, described in [16], also focuses on awareness about privacy risks in SNSs. The game is a fake SNS and is developed to be played individually by teenagers. A player takes the role of a web detective and attempts to solve missions through searching for information on profiles on the fake SNS. An example mission is to try to locate a person at a certain moment.
- *Google's Interland*[1], aims at educating children in four areas of internet security: Cyber bullying, phishing, password creation and sharing awareness. The player controls a character through different games, scoring points for completing tasks, while learning about safe Internet behavior at the same time.

The aim of our research is to investigate how to foster human-centered design of novel games for promoting awareness about privacy by providing tools to engage teenagers in idea generation. Focusing on the recognized importance of the ideation phase in any design method [6], this paper presents a card-based ideation workshop, i.e. a tool supporting the collaborative formulation of initial game concepts. The workshop, called *Privacy Game Co-Design Workshop*, is intended for non-experts, i.e. users without previous knowledge on the field of privacy or formal training in design techniques, with focus on teenagers as the main target group. The proposed workshop is an adaptation of the Triadic Game Design workshop [8]. It provides: (1) a structured process to guide ideation; (2) a board to focus the contribution of the players; and (3) a set of cards to focus on different aspects of the games.

The design of the workshop was an iterative process. We evaluated its usefulness in informing and guiding idea generation during two pilots and a final evaluation with 32 participants divided in 9 groups. Data was collected through observations, questionnaires, artifact analysis, and, for the pilots, a final group interview.

All workshop material is released under a Creative Commons license and available for download at *omitted for anonymity*.

2 Related work and background

The work presented in this paper is positioned in the research that aims at using card-based approaches to promote idea generation and playful user involvement in co-design [15]. As examples, in [12] the authors propose a set of cards and a structured workshop to promote co-design of IoT systems. Similar approaches are also used in game design, as e.g., in the work connected to tangible interfaces for learning games [5], for exertion games [13]; and to design for playfulness [11]. Cards are an effective vehicle to convert theoretical frameworks to guidelines that can be manipulated by designers [5], keeping users at the center of the design process [10, 11] and facilitating creative dialogue and shared understanding. Cards can be a source of inspiration to steer a discussion when it becomes unproductive [11]. Cards facilitate collaborative and divergent thinking by providing a medium for conversation between stakeholders and designer [2, 7], and providing a common ground [1]. As summarized in [12], card-based tools are ":..(i)

1. Interland - Be Internet Awesome. Retrieved October 1, 2017 from https://beinternetawesome.withgoogle.com/

informative: helping to describe complex concepts to non-experts, (ii) inspirational: helping trigger and guide brainstorming and idea generation, (iii) collaborative: engaging users by helping collaboration and creative dialogue…" However, cards should not be seen as stand alone, but rather complemented by clear guidance on how to use them [13], possibly in the context of a structured workshop process.

In this context, we chose the Triadic Game Design [8] workshop as a foundation for our Privacy Game Co-Design Workshop. The Triadic Game Design is intended to support the design of serious games by pushing the designer to address in turn three core perspectives:

1. *Play*: how to make a game entertaining. Only considering this element would be the same as designing a regular game with no learning goals.
2. *Meaning*: how to make the game education. The game designed should provide a value beyond play itself like educating or raising awareness.
3. *Reality*: to ground the game in a specific real-world context.

In order to make a successful serious game, these three perspectives must be balanced, and they can complement each other or be conflicting. The proposed workshop is intended to have a flexible format and to adapt to different needs. In the original version of the workshop, participants are divided in groups of 3-4, and after an ice-breaking activity, they go through different assignments, the first three focusing in turn on each of the three core perspectives listed above plus a last one to bring the three elements together. For each assignment, a deck of cards is provided, identifying possible choices for the participants. In addition, a set of worksheets is used to provide questions that guide the creation of the game as well as space for recording design choices.

The Triadic game design workshop focuses on the creation of concepts rather than technology or graphics. This is the main reason it has been chosen as starting point for the approach proposed in this paper. However, it has been adapted to target privacy and suit better to teenagers.

3 The co-design workshop

The Privacy Game Co-Design Workshop aims to include the target group as participants in a workshop to help generate ideas for serious games focused on privacy awareness. The goal is to be able to run the workshop in a classroom-setting with groups of 3-6 people and therefore generate multiple ideas (Fig. 1). The design of the workshop has been an iterative process. The authors used the Triadic Game Design workshop as a core, and made changes to adjust the workshop time scope, audience and altered the focus from "any" problem to privacy. The resulting workshop includes (1) a structured process to guide ideation; (2) a board to focus the contribution of the players; and (3) a set of 30 cards helping participants to focus on different aspects of the games they are conceiving. The 30 cards are divided into 7 Reality cards, 1 Meaning card, 14 Play cards and 8 Technology cards.

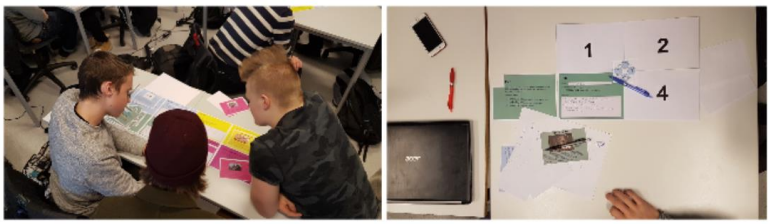

Fig. 1. Students during one of the workshops

3.1 The Process

The Privacy Game Co-Design Workshop is intended to last 2-3 hours. All groups have to sequentially look at the design of their game from 4 different perspectives. In addition to Reality, Meaning, and Play, that are part of the original approach, we have added Technology. This is mainly intended to go beyond traditional video games. Therefore, the workshop has four distinct phases, one for each of the design perspectives. For each phase, groups have to: (i) Open the part of the board connected to the specific design perspective; (ii) Choose or draw a card from the associated deck, (iii) Work on their idea following the prompts on the board, and (iv) Give a 1-minute pitch of their idea.

Each phase should take approximately 30 minutes. It is difficult to set a firm time-limit on each step within the 30 minutes, as they are fluid and often overlap, though Step (iii) should take the most time, as it is where groups generate their ideas.

Rather than an initial ice-breaker activity like in the original workshop, the workshop includes an initial introduction to privacy. Though this initial part might be tailored, we have developed a Kahoot! quiz[2] and a short lecture about: What is privacy? What is online privacy? Risks of sharing personal information with other people/friends, and Risks of sharing personal information with companies or organizations through usage of services. Kahoot! and lecture notes are available at *omitted for anonymity*.

3.2 The Board

The original workshop provides detailed worksheet templates to document design choices. Since we aim at a shorter activity and at the involvement of teenagers, in our adaptation we decided to substitute the worksheets with a board. The board is used: (i) to scaffold the process, (ii) to collect ideas and notes during the process, and (iii) to support cooperation and interaction within the group. Because of its size (A2 format), the board enables 3-4 people to easily work around it.

At the beginning of the workshop, each group receives a board that they can write on. The board is divided in 4 areas, one for each of the workshop phases (Fig. 1, right). The areas are covered, and the groups have to discover the areas only during the related workshop phase. This is intended to help them focus. When an area is open, there are

[2] https://kahoot.com/welcomeback/

two sheets supporting the discussion. As an example, Fig. 2 shows the two sheets for the Reality phase. On one side there is a short description of the phase and the steps that have to be followed. On the other, there are some questions that are intended to trigger the discussion within the groups and an area to annotate the discussion and ideas. In the sheet they can also select if they want to address challenges connected to the private sector or related to the use of personal data by companies.

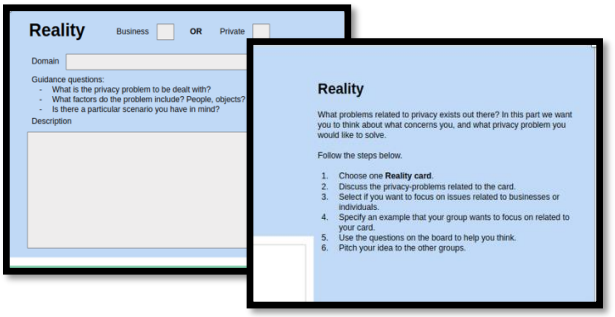

Fig. 2. Board components of *Reality*

3.3 Cards

The Privacy Game Co-Design Workshop uses four sets of cards, one of each phase of the workshop.

- *Reality*. While the original workshop is open to any domain, in our workshop we focus on privacy and all the cards for reality are on privacy, each representing a different privacy scenario that can be addressed in the game. The reality cards are: Location Sharing; Smart Cities (example in Fig. 3, left); Health Devices; Activity Trackers; Social Media; Mobile App Permissions; Loyalty programs. The scenarios have been defined by analyzing cases reported in the media. The list of privacy problems is not exhaustive and can be extended to address other scenarios. The description of the scenarios is, by choice, broad enough to be interpreted in different directions, but still specific enough to provide focus on privacy.
- *Meaning*. The original workshop includes a number of cards for promoting creativity around meaning. However, since the game that we aim at designing are connected to increasing awareness of privacy, we limit to the most relevant card, "Awareness and Attitude", i.e., the developed games will all focus on increasing awareness or change attitude towards data sharing.
- *Play*. The cards to support participants in thinking about different types of game are the same than in the Triadic workshop, but text has been simplified to fit better to the target group and the game examples have been updated.
- *Technology*. This deck of cards does not exist in the original workshop, but we have introduced it to promote the development of games that use a broader spectrum of

technologies. Technology cards specify what kind of technology the serious game will be utilizing. Having a specific technology to design the game for may help the participants to move away from traditional PC games and promote creativity. The technology cards are: Augmented Reality (example in Fig. 3, right); Virtual Reality; Mobile; Computer; Console; Interactive Surfaces; Interactive Devices.

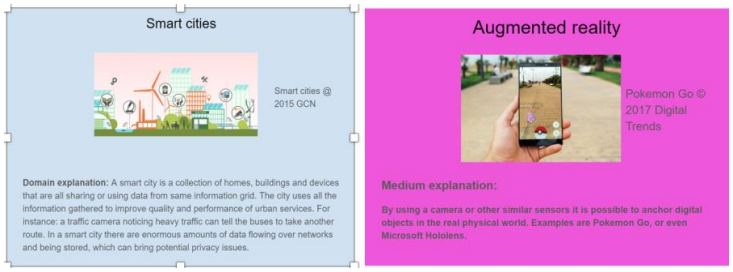

Fig. 3. Example of a Reality card (left) and a Technology Card (right)

4 User studies

The workshop has been evaluated through two small pilots, mainly intended to fine-tune the workshop, and then a larger evaluation. Data was collected through: a questionnaire using a 1-5 Likert-scale and focusing on fun and perceived difficulty level; artifact analysis, i.e. the annotated boards; and observations by three of the co-authors who also acted as facilitators, with individual observations discussed in the team after the workshop. For the two pilots, the study also included an audio recorded group interview with all participants. The researchers sought to have a free group discussion, without a structured set of questions in order not to constrain what the participants might say, as discussed in [4]. For the final evaluation, no final interview was conducted because being in a school there were more time constraints.

The participants to the studies were all teenagers in upper secondary schools. The first pilot was conducted with 3 participants who were spending two weeks at the university as part of their vocational education in ICT (Information and Communication Technology) and service design. The second pilot was conducted with 6 participants that were working at the university as part of a national program for which students in secondary schools can work one day in companies to collect money for a charity. The first group was therefore not compensated, whereas the second group received indirect compensation, circa 50 euro each, to charity. The final evaluation was conducted with two classes of a school with specialization in ICT, with a total of 32 students divided in 9 groups. The pilots were conducted at the university premises, while the final evaluation was conducted at the school. Participation of girls was very low, with only two girls attending the second pilot and 1 the final evaluation. We therefore do not perform any analysis of gender issues.

The first pilot was conducted with an earlier version of the workshop. The workshop was then revised based on the results. The workshop as described in the previous section is the one resulting from this revision and it is the version that is evaluated in the second pilot and in the final study.

4.1 Results from the pilots

During the first pilot, the 3 students were put into one group. Participants were given a first version of the board, the Privacy cards as described above, all the Play and Meaning cards in the original Triadic workshop (updated and simplified), and the Technology cards. The group was able to conceive a relevant and interesting game idea, but they did get stuck on several occasions, and they needed help to get back on track. They also struggled to detach their ideas from the game examples in the cards. However, the questionnaire results show that the participants enjoyed the workshop. Their answers suggest that Part 1 (Reality) was the most boring, with a fun rating of 3.33, and the most difficult to combine with the other elements. They all stated that they had sufficient time for each part. The group discussion after the workshop confirmed the observations. The main concern of the participants was the difficulty to put together all the previous steps in the final game, especially the scenario from the Reality phase. As stated by one of the participants: "*Combining three of the parts wasn't difficult, but getting Reality to fit in was very challenging*."; and as stated by another one: "*The difficult part is to make the privacy an essential part of the game while still keeping it interesting*". Discussing the Meaning cards after the workshop, there was also a general consensus that many of the cards in the deck are difficult to understand, and that "Attitude" is the card best related to privacy risks. Many of the meaning cards wouldn't actually make sense in the given context.
As a result of the evaluation, the following changes were made:

- Participants are able to choose the Reality card (privacy scenario) they want to work with, but all the cards are presented at the beginning of the process. Combining all the elements proved too difficult, and Reality the most difficult one to incorporate. By letting the participants choose reality card it will be something they understand.
- All the Meaning cards are removed from the deck, except for the "Attitude and Awareness" to focus on the fact that the games that have to be designed are aimed at changing attitudes and increase awareness, not developing any generic skill.
- Redesign of the board to use better the available space, but also to help participants to concentrate more on the task at hand.

The participants of the second pilot were divided in two groups. Both groups were able to generate a relevant game. The process was smoother, with less breakdowns. The results from the questionnaires confirm the observations. The participants appreciated the presentation of each reality card before they selected one, as opposed to Pilot 1 where they drew a card blindly. As one participant stated:
"It was nice to be able to choose [reality card]. It made it easier to come up with interesting angles for the game. The Play part was more difficult since the genres were untraditional and we had to think outside the box."

Facilitator: "*Is that a bad thing*?" "*No, creating yet another Call of Duty2* [a successful first-person shooter game] *would have been boring. It was fun but challenging*."

In the second pilot there was no evidence that Phase 4 (working on technology and combining all previous parts) was hard. The fun-rating of part 4 was also higher than in Pilot 1. The groups felt they had sufficient time for each task, supporting the results from the first iteration. As a result of the second pilot only minor changes to the text on some cards and on the board were introduced.

4.2 Results from the main evaluation

The participants seemed to enjoy the workshop and worked well with the tasks, though they had to be reminded frequently to write down their ideas in the board. The different phases received increasing higher score in the questionnaire, with the last phase receiving the highest score, over 4 on average. The workshop seems to hit an appropriate difficulty level, with 23 out of 32 participants reporting the workshop to be neither easy nor hard, and only 2 experiencing it as difficult. Most of the participants also felt that they had enough time for the workshop (26 out of 32).

A general positive attitude was also observed during the pitches, during which students seemed to enjoy presenting their ideas and listening to what the other groups had done. It is however worth to note that some of the pitches were very effective in presenting the ideas, while others were harder to follow, with poorer explanation of the context. Questions had to be asked to facilitate the pitching and clarify details.

The proposed game ideas were evaluated by the three facilitators when the groups performed their final pitch. The average of these scores can be seen in Fig. 4. The facilitators independently rated the ideas based on:

- Privacy Scenario, how well defined the problem statement/scenario was. Did they think of the different roles, why it is a problem, provide an example.
- Raising Awareness, did the participants find a problem to promote awareness for? Did they find a game, and did they modify it in a meaningful way?
- Entertainment Value, did they define goals, rules, and story for the game? Did it seem like a fun game to play?
- Innovative, did the group come up with a creative new game concept? Did they combine existing concepts in an interesting way?
- Overall Impression, the subjective overall impression.

The maximum possible score was 50 points, the highest given score 39 and the lowest just above 28. Most of the scores were in the mid 30's range. Most of the groups scored high on innovative thinking, with 7 of 9 groups with a score of more than 7 out of 10.

Table 1 provides an overview of the game ideas generated during the final evaluation, specifying which cards have been used, the game concept, and the score.

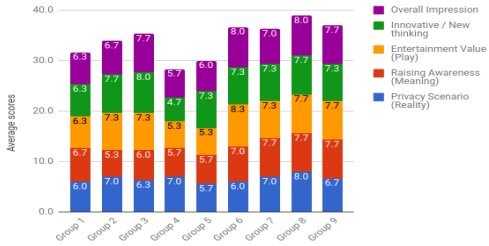

Fig. 4. The average scores for each group in the five aspects their ideas were rated.

Table 1. Table showing selected cards, game concept, and total score evaluating the game.

ID	Reality	Play	Tech.	Game concept	Sc.
1	Social Media (Business)	Strategy	Aug. Reality	The player explores the real world and using his phone with AR can hack the information of virtual companies. The information can be traded for money and other goods.	31,7
2	Social Media (Private)	Shooter	Virtual Reality	Your job is to explore the world and detect fake profiles on Tinder. By using a shotgun you exterminate the fake users one by one.	34,0
3	Social Media (P)	RPG + Adventure[1]	Virtual Reality	In a VR world the player takes pictures of objects and post them to social media. This can give the player fame, or have grave consequences if wrong picture is posted.	35,3
4	Smart Cities (B)	Survival Horror	Console	The player must survive in a smart city using stealth to not be detected by the government or hacked.	28,3
5	App Permissions (P)	Survival Horror	Computer	A puzzle game where the player give permission to all his personal information. If he doesn't finish the puzzle everything is posted to social media.	30,0
6	Smart Cities (P)	Adventure, Survival Horror	Console	A game where the state has gathered a lot of personal data about the player in a post-apocalyptic setting, and the player must prevent them from abusing it.	36,7

7	Health Devices (P)	Platform	Computer	Open world game, player is prompted to share private information. Can interact with other people to learn from mistakes.	36,3
8	Social media + Mobile App (P)	Adven-ture	Computer	The player discovers that an SNS uses private information illegally and must decide what to do in a decision-based game.	39
9	Smart Cities (P)	Action	Computer	First person stealth game, where the player attempts to infiltrate and take down an "evil" organization that abuses personal data without giving away personal data.	37

5 DISCUSSION

The Privacy Game Co-Design Workshop proved successful in supporting the co-design of serious games for privacy awareness. The results show that, in a limited amount of time, the participants were able to:

- Select and elaborate a privacy-related scenario
- Give a meaning to an existing game, i.e. turning an existing game into a game with a learning purpose
- Come up with a fun new game in a specific genre
- Reflect and combine the elements into one serious game for privacy awareness.

On the overall, the changes made to the original workshop are evaluated positively for the intended purpose. The workshop was perceived by students as an engaging activity and all the groups managed to come up with relevant ideas. As shown in Table 1, the groups produced ideas for different scenarios. It is interesting to underline that only 4 out of 9 ideas are related to social media, that is what normally students get information about. Also, 5 ideas do not use the computer as underlying technology, again increasing the potential innovativeness of the game.

Having a structured *process* proved to support generation of creative ideas. Through the different phases participants focus on different perspective of serious games and advance their design. In the pilot tests we experimented with letting the participants choose all their cards, as opposed to draw them, but feedback showed that this only lead to confusion. The participants were often excited to include different cards that did not seem to fit together, i.e., Social Media, Virtual Reality and Role-Playing Games. The resulting game idea was often very innovative and successful. That creativity permeates the entire process is also visible in the results, with 7 out of the 9 final game ideas receiving high scores on innovation.

The *cards* played their expected role of informing participants about different options, triggering discussion and idea generation, and promoting cooperation providing specific concepts for focus on.

The *board* provided a focal point for group interaction and scaffolding of the process, by providing different hints about the process as well as triggers to help the group to focus. The evaluation revealed however that the participants did not use the board as much as intended, often forgetting about the guidance questions meant to help their creative process. This might result in games that are less elaborated as well as in a more frustrating process. It is also important to note that the boards are an important outcome of the co-design workshop and are essential for designers who want to take the games further. It is therefore important that the workshop facilitator makes sure to give clear instructions and reminds participants about the proper use of the board.

Several of the games designed by the participants could be promising tools to raise privacy awareness. A challenge with advancing the ideas to game development is that they are often very complex as well as costly and difficult to realize. However, asking the participants to only create simple games is very likely to hinder their creative process and affect the final ideas. It is also important to note that the facilitators of the workshop are not necessarily looking for a final concept to implement, but rather ideas that can be combined or used as inspiration for creation of relevant serious games.

A recurring theme in the games from the workshop is to raise awareness by having in-game actions result in consequences. This applies to both negative actions, such as over-sharing of information, and positive actions, such as making good decisions. A drawback of using consequences of all actions as a mechanism to teach privacy awareness is that it requires a lot of resources in development to foresee and design all possible outcomes in the serious game.

The proposed workshop is intended to last between 2-3 hours to provide an activity that can easily be integrated into a busy school day. However, the evaluation shows that an extension of the activity might be beneficial. In particular, if there is time, the facilitator might consider using more time to provide: a more extensive introduction to privacy; more time for discussion after the pitches to generate knowledge exchange among the groups; starting a class discussion among the ideas.

6 CONCLUSIONS

In this paper we presented a workshop to promote co-design of games aimed at promoting awareness of privacy among teenagers. The workshop includes a structured process to be used together with a board and cards. The workshop is an adaptation of the Triadic Game Design Workshop previously proposed in the literature. In addition to a general update of the cards proposed in the original workshop, the main proposed changes include a focus on privacy through the introduction of a deck of cards capturing different privacy scenarios; the introduction of a technology perspective and related cards, to promote the design of games adopting novel interaction approaches; the introduction of a board to scaffold the process and promote cooperation. The workshop has successfully been evaluated with 32 students.

The participants of the main evaluation were all ICT students aged 15-17, with only one girl. The workshop needs therefore to be evaluated with a more diverse population. As part of our future work, we also aim at studying how the workshop can be used not only as a co-design tool, but also as a tool to promote learning of privacy in schools.

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Appendix B

PrivaCity Questionnaire

PrivaCity Questionnaire

Thank you for playing the game PrivaCity! Please answer the following questions. The answers are anonymous and will be treated confidentially.

Read more here: https://goo.gl/NkzaAj

* Required

1. **ID** *
   Can be found together with the link in the game chat.

   _____

2. **Age**

   _____

3. **Gender**
   Mark only one oval.

   - ◯ Female
   - ◯ Male
   - ◯ Other: _____

4. **How many hours do you spend playing video games per week?** *
   Mark only one oval.

   - ◯ 0-1
   - ◯ 1-5
   - ◯ 5-10
   - ◯ 10-20
   - ◯ 20+

5. **Have you interacted with a chatbot before?** *
   Mark only one oval.

   - ◯ Never
   - ◯ Once
   - ◯ A few times
   - ◯ Often
   - ◯ Don't know

6. **How is your overall impression of the game?** *
Mark only one oval.

	1	2	3	4	5	
Very poor	◯	◯	◯	◯	◯	Very good

7. **How did the use of emojis affect the game?** *
Check all that apply.

- [ ] More fun
- [ ] Easier to understand
- [ ] Annoying
- [ ] Confusing
- [ ] Did not affect
- [ ] Don't know
- [ ] Other: _____

Engagement

8. **I felt free to explore the levels in the game** *
Mark only one oval.

	1	2	3	4	5	
Disagree	◯	◯	◯	◯	◯	Agree

9. **How difficult was each level?**
Only the levels you played.
Mark only one oval per row.

	Very easy	Easy	Medium	Hard	Very hard
Hotel room	◯	◯	◯	◯	◯
Elevator	◯	◯	◯	◯	◯
Hotel Lobby	◯	◯	◯	◯	◯
Cafe	◯	◯	◯	◯	◯
(Infiltration) Interview	◯	◯	◯	◯	◯
(Infiltration) Listen to recordings	◯	◯	◯	◯	◯
(Sneaky) Closet	◯	◯	◯	◯	◯
(Sneaky) Whiteboard password	◯	◯	◯	◯	◯
Destroy server	◯	◯	◯	◯	◯

10. **How entertaining was each level?**
Only the levels you played.
Mark only one oval per row.

	Very boring	Boring	Medium	Fun	Very fun
Hotel room					
Elevator					
Hotel Lobby					
Cafe					
(Infiltration) Interview					
(Infiltration) Listen to recordings					
(Sneaky) Closet					
(Sneaky) Whiteboard password					
Destroy server					

Learning

11. **I have learned something about privacy in Smart Cities from playing the game** *
Mark only one oval.

	1	2	3	4	5	
Disagree						Agree

12. **I feel more aware towards privacy in general after playing the game** *
Mark only one oval.

	1	2	3	4	5	
Disagree						Agree

13. **I believe I will change my behavior towards privacy.** *
Mark only one oval.

	1	2	3	4	5	
Disagree						Agree

14. **Which of the following game elements helped raise your privacy awareness?** *
Check all that apply.

- [ ] Quiz
- [ ] Consequenses of action
- [ ] Being the "bad guy"
- [ ] Rewards (points, game money)
- [ ] Real life examples
- [ ] Summary
- [ ] None of the above
- [ ] Other: _____

15. **Do you have any other feedback on the game?**

_____

_____

_____

_____

_____

Appendix C

Minor Changes to PrivaCity

Table C.1: Minor changes made to PrivaCity during/after pilot testing, not included in the changelog.

Participant	Level	Description
1020	2	Feedback that back in lobby after doing quiz.
	2	Show that taking the taxi costs money
	3	Improve transition between level 3 and 4/5
	6	Fix emoji bug in level 6. Lingering from previous level.
	Summary	Link to correct questionnaire.
1598	Intro	Capitalize C in PrivaCity
	0	Make level 0 more foolproof
	1	Make HINT more explicit
	2	Add intro for quiz-o-mat
	3	Typo in ”messing with the light”
	3	No response on drink coffee
	4.1	Tell player that back in room after exiting closet
	4.1	Change name of level 4.1 in questionnaire
	4.2	Provide new hint after looking at painting
	Summary	Add ”maybe” to privacy is a trade-off
	Summary	Incorrect ->Wrong
	Summary	Simplify deprive
1784	3	Make it clear that the goal is to destroy the server no matter which path is chosen.
	5.1	Add ”As you may have read in the newspaper” about crime-rate
	5.2	Include typing indication before ”Please classify the recordings”
1551	0	Bigger font in the newspaper
	1, 2	Bigger font in the messages
	3	Fix sendtyping bug with receptionist
	3	Receptionist says ”sir” to everyone
8117	0	Add key emoji to ”open door”
	4.2	Bigger font on hint sheet
6906	Intro	Don’t restart introduction upon input

Table C.2: Utterances trained during/after pilot testing.

Participant	Level	Utterance
1020	0	Put key in door
	4.1	Open drawers
	4.2	Put paper with holes on other paper
1598	0	Walk out the door
	3	Talk to men
	3	Barista
	4.1	Closet
	4.1	Write
	4.2	Paper
	4.2	Candy
1784	3	Talk to the blogger
1551	4.1	Drawers
	4.2	Equations
	4.2	Paper with holes on top
8117	0	News
	0	Examine room
	1	Open doors
	1	Doors
6906	3	Look at coffee
	4.1	Open door
	4.1	Cabinet

Appendix D

PrivaCity Game Details

D.1 Quiz Questions

The quiz questions from Level 3 are presented as JavaScript objects:

```
var q1 = {
  question: "Can Snapchat sell your pictures?",
  image: "",
  choices: ["Yes", "No"],
  correct: "Yes",
  explanation:
    "Actually, according to the Snapchat privacy declaration,
        they can sell content to third parties without any
        responsibility for how the data is used.\n\nThat is
        scary! ",
  explanationUrl: "https://www.snap.com/nb-NO/privacy/privacy-
      policy/"
};

var q2 = {
  question: "How is information collected in a Smart City?",
  image: "",
  choices: ["Spies", "A Questionnaire", "Digital Sensors", "
      Trained Birds"],
  correct: "Digital Sensors",
  explanation:
    "A smart city is an urban area that uses different types
        of digital data collection sensors to supply
        information which is used to manage the city
        efficiently."
};

var q3 = {
```

```
  question: "Does facebook know which other web pages you
      visit?",
  image: "",
  choices: ["Yes, always", "With a share button", "No, never",
       "That is illegal"],
  correct: "With a share button",
  explanation:
    "If a web page contains a 'Like' or 'Share' button,
        Facebook can use cookies to know that you have visited
         the page, and maybe share that information with
        others."
};

var q4 = {
  question: "Can Facebook sell your information to other
      companies?",
  image: "",
  choices: ["Yes", "No"],
  correct: "Yes",
  explanation:
    "When you created a Facebook profile, you have agreed to
        Facebook's privacy statement which says that the
        personal information collected may be shared with
        other companies. Unless you explicitly has told them
        not to.",
  explanationUrl: "https://www.theguardian.com/news/series/
      cambridge-analytica-files"
};

var q5 = {
  question: "Can the data collected in a Smart City be abused
      ?",
  image: "",
  choices: ["Yes", "No"],
  correct: "Yes",
  explanation:
    "The information collected in a smart city can be used to
        create a safer, cleaner, more sustainable and
        efficient city. However, this same information can
        also be abused to violate the privacy of its citizens
        ."
};

var q6 = {
  question: "Does all mobile applications have access to your
      position?",
  image: "",
  choices: ["Yes", "No, need permission"],
  correct: "Yes",
  explanation:
```

```
        "To access your position, the application needs your
            explicit permission. This is a trade-off which the
            user has to make. Will allowing the application access
             to your location provide an improved service? How can
             the application abuse this personal information?"
    };

    var Quiz = {
      questions: [q1, q2, q3, q4, q5]
    };
```

D.2 Privacy Classifications

The privacy classifications from Level 4.1 are presented as JavaScript objects:

```
    var q1 = {
  statement: "Listen to all conversations through microphones
      hidden in children toys.",
  violation: true,
  explanation:
    'This is a violation of user privacy. The doll "Cayla" was
        actually removed from market as its recordings could be
        easily hacked. '
};

var q2 = {
  statement: "Increase traffic flow by monitoring which roads are
      most used",
  violation: false,
  explanation:
    "As long as the data is anonymized, this isn't a privacy
        violation, and is one of many ways which smart cities can
        be used to improve efficency."
};

var q3 = {
  statement: "Using location data from smart phones to determine
      people's location at all time.",
  violation: true,
  explanation:
    "Location data from people should not be used to monitor
        single individuals, but rather in anonymized collections
        of data."
};

var q4 = {
  statement: "Smart street lights that adjusts to natural lighting
       and people nearby.",
  violation: false,
```

```
  explanation:
    "Barcelona actually has a smart lighting system doing exactly
        that, and more, saving the city as much as 40% in lighting
         costs."
};

var privacy_classification = {
  statements: [q1, q2, q3, q4]
};
```

D.3 Eavesdrop Classification

The privacy eavesdrop classifications from Level 5.2 are presented as JavaScript objects:

```
    var q1 = {
  recording: "Hey, honey. Have you heard about how the new
      government are tracking us? They are criminals!!",
  correct: "Critical to state",
  explanation_correct: "Good call, this man sounds critical to our
       masterplan",
  explanation_wrong: "Are you sure, he sounded pretty critical to
      me.."
};

var q2 = {
  recording: "Look at this video, cats are so stupid!",
  correct: "Not interesting",
  explanation_correct: "Yeah, everything gets recorded, and there
      is a lot of casual talk.",
  explanation_wrong: "Not sure about that, everyone likes cat
      videos.."
};

var q3 = {
  recording: "Baby, my husband must never know what we are doing
      when he's at work" + emoji.get("kiss"),
  correct: "Blackmail",
  explanation_correct: "Haha, we can definitely use that against
      the cheating wife in the future",
  explanation_wrong: "Hmm, it sounded like she was having an
      affair. And that can be used for blackmailing."
};

var q4 = {
  recording: "I hate how the government are monitoring our every
      move! Hope someone can take them down.",
  correct: "Critical to state",
  explanation_correct: "I agree, we should keep an eye on this guy
      ",
```

```
  explanation_wrong: "He seems critical to the state, and should
      be kept an eye on"
};

var q5 = {
  recording: "Oh, shit! Clamydia?!?! My girlfriend cannot find out
      .",
  correct: "Blackmail",
  explanation_correct: "Haha, should've used a condom" + emoji.get
      ("joy"),
  explanation_wrong:
    "Haha, should've used a condom" + emoji.get("joy") + " But I
        think we could use that for blackmail."
};

var eavesdrop = {
  recordings: [q1, q2, q3, q4, q5]
};
```

Appendix E

Consent Form to Take Part in the Research Project

Umi-Sci-Ed-prosjektet - Informasjonsskriv - voksne deltakere eller andre interessenter

Informasjonsskriv om deltakelse i forskningsprosjekt

"Exploiting Ubiquitous Computing, Mobile Computing and the Internet of Things to promote Science Education (UMI-Sci-Ed)"

Formål

Formålet med UMI-Sci-Ed-prosjektet er å utnytte moderne teknologi til å fremme teknologiutdanning. UMI-Sci-Ed har som mål å hjelpe ungdommer til å tenke kreativt, til å bruke ny kunnskap på en effektiv måte, og til å bli kontinuerlig konkurransedyktig i et høyt krevende arbeidsmiljø. UMI-Sci-Ed sin arbeidsstil er entreprenøriell og tverrfaglig, og ønsker å øke gutter og jenters motivasjon for teknologiutdanning samt å øke engasjementet for å velge altomfattende-, mobilteknologi og IoT som karrierevei. Teknologiske institusjoner (CTI, CIT, CUBIT) og akademiske organisasjoner (University of Helsinki, Norges teknisk-naturvitenskapelige universitet (NTNU) og University of Pisa), er de grunnleggende deltakerne og partnere i UMI-Sci-Ed-prosjektet. Prosjektet er finansiert av EU-kommisjonen. Mer informasjon om prosjektet finnes på http://umi-sci-ed.eu/.

Tidslinje og viktige stadier

Prosjektet startet i mai 2016 og vil bli avsluttet i mai 2019. I løpet av det tredje året av prosjektet vil prosjektet involvere fem skoler fra hver av de akademiske partnerne (Norge, Finland, Italia, Irland og Hellas) og 24-30 elever per klasse.

Hva vil det si å delta i dette prosjektet?

Studentene vil delta i aktivitetene, som for eksempel, teste et spill; fylle ut spørreskjemaer for å samle meninger, bakgrunnsinformasjon, og tilbakemeldinger på opplegg. Eventuelle lærere og foresatt/foreldere har rett til å få informasjon om aktivitetene. Det vil bli gjort lydopptak av utførelse og diskusjon (etter muntlig samtykke av deltakeren) for å gjøre det lettere for forskerne å notere informasjonen.

Hva vil skje med informasjonen om deg?

All personlig data vil bli behandlet konfidensielt. Opptak vil kun bli håndtert av prosjektgruppen på NTNU. Data fra intervjuet vil bli anonymisert, og hver deltaker vil bli tilegnet en unik brukerkode som vil hjelpe prosjektgruppen til å anonymisere informasjonen slik at ingen deltakere vil være mulig å identifisere. Partnere av UMI-Sci-Ed-prosjektet vil ha tilgang til deler av den anonymiserte dataen. All data vil bli bevart anonymt i databaser som kun lagrer brukerkoden. I tilfelle noe av informasjonen blir publisert innenfor forskningsmiljøet, vil ikke deltakerne være gjenkjennelig i publikasjonen. Prosjektet vil bli avsluttet innen 31. mai 2019 og etter dette vil dataen bli lagret i et år til før dataen vil bli destruert.

Frivillig deltakelse

Det er frivillig å delta i prosjektet, og du kan når som helst velge å trekke tilbake ditt samtykke til å delta uten å måtte oppgi noen grunn for dette. Hvis du bestemmer deg for å trekke deg vil all din personlig informasjon bli gjort anonym. Hvis du ønsker å delta i prosjektet eller hvis du har noen spørsmål angående prosjektet, ta gjerne kontakt med professor Monica Divitini (telefonnummer: 91897790, epost:

divitini@idi.ntnu.no) som er prosjektleder for prosjektet, eller Anna Mavroudi (telefonnummer: 45243546, epost: anna.mavroudi@ntnu.no) som er en forsker som jobber i prosjektet.

Samtykke til å delta i prosjektet

Samtykke til å delta i prosjektet oppnås ved å fylle ut skjemaet nedenfor. Hvis du er yngre enn 15 år, må din forelder/foresatt lese gjennom informasjonsskrivet og skrive under på vegne av deg. Hvis du er eldre enn 15 år, kan du selv skrive under på dette etter å ha informert dine foreldre/foresatte.

For studenter som er **eldre** enn 15 år:

Jeg, deltakeren, har mottatt informasjon om prosjektet og er villig til å delta

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(navn på deltaker, signatur, dato)

For studenter som er **yngre** enn 15 år:

Jeg, foresatt/forelder av deltakeren, har mottatt informasjon om prosjektet og gir samtykke til at deltakeren kan delta

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(navn på foresatt/forelder, signatur, dato)