



App Store Ethics: The Game

Developing a Web-Based Tool using Game-based Learning
for Educational Environments

Bachelor's thesis in Computer science and engineering

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Abstract

Ethics have become an increasingly important subject in the field of computer science, but not every curriculum within the field integrates ethics. Our thesis presents a web-based game that could be used by teachers as an educational tool in ethics courses in computer science and information technology. The game is designed to stimulate reflection on ethical dilemmas within computer science. This is done by putting the user in the shoes of an App Store employee, who is presented with different applications to decline or release onto the App Store. The choice the user takes then leads to fictional ethical consequences, which should make the user reflect on their choices and in turn lead to more ethically aware computer scientists in the future. The applications and their consequences are created as placeholders for enabling testing of the game. The project was designed to be extendable and modular so that future applications and features can be added smoothly. This report describes the iterative process of creating and shaping the game and ends with a final evaluation of the finished product. A final evaluation was performed on students in Interaction design. A majority of the participants of the final evaluation found the game enjoyable and suitable for encouraging discussions about ethics in an educational setting.

Keywords: Game-based learning, Computer Science, Ethics, Education, Web-based, Design Fiction, Prototyping, User testing

Sammandrag

Etik har blivit ett allt viktigare ämne inom datavetenskap, men alla program inom datavetenskap inkluderar inte undervisning inom etik. Denna uppsats presenterar ett webbaserat spel, som kan användas som ett pedagogiskt verktyg inom etiska kurser i både datavetenskap och informationsteknik. Spelet ska uppmuntra till diskussion av etiska dilemmor inom datavetenskap, och detta sker genom att sätta användaren i skorna av en App Store-anställd. Användaren presenteras sedan med olika applikationer att neka eller släppa för försäljning på App Store. Användarens val leder sedan till fiktiva etiska konsekvenser, vilket ska få användaren att reflektera över sina val, och i sin tur leda till mer etiskt medvetna utvecklare i framtiden. Applikationerna och konsekvenserna är temporära och skapades i syftet att möjliggöra testning av spelet. Kodbasen designades för att vara utbyggbar och modulär så att framtida appar och funktioner kan läggas till smidigt. Denna rapport beskriver den iterativa processen av att skapa och modifiera spelet och avslutas med en slutlig användarevaluering av slutprodukten. Enligt resultaten från den slutgiltliga utvärderingen tyckte majoriteten av deltagarna att spelet var underhållande och lämpligt för att uppmuntra diskussioner om etik i ett utbildningssyfte.

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Daði Andrason, Emmie Berger, Julia Böckert, William Johnston, Steffanie Kristiansson, Olivia Månström, Gothenburg, May 2024

Glossary

Computer Science The study of software and software systems, which focuses mostly on algorithms and computational theories for example.

App Store A platform for downloading applications on devices such as mobile phones or computers.

Low-fidelity prototype The initial view of the future interface and functionality of the end product.

High-fidelity prototype A representation of the interface and functionality of the end product.

Serious game A game that has another primary purpose other than for entertainment purposes.

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1

Introduction

With the growing reliance on digital technologies, developers have a tremendous impact on the lives of many people. The developers must ensure that the technology they develop is not only functional but also takes ethical matters into account. Furthermore, they must have the knowledge required to create secure, non-discriminatory, and fair products.

Developers often get an education in university programs, such as computer science or information technology. Research in Europe and the US has shown that despite high motivation, ethical aspects are often not taught to a high extent [1] [2]. Even when ethical aspects are included, the content, quantity, and teaching methods differ significantly between institutions and programs. Varying content and teaching approaches does not necessarily mean poor teaching, but rather how wide the topics of ethics are and that there are many ways to approach them. However, many institutions wish to teach it more but lack the knowledge or experience to do so.

Games can be used as an effective learning tool and are often well received among students [3] [4]. For example, they are used in software engineering to practice management [5]. Therefore this project presents a game with fictional ethical dilemmas in technology, to solve the challenge of having interesting and relevant discussions about ethics in computer science. The aim is that the game can be used as a medium by teachers in computer science classes. The teachers should create their own dilemmas to fit with their particular course and class. The game content presented in this report should be seen as placeholder examples of ethical dilemmas. They are not necessarily suitable for teaching since they are created by the authors, who are students with minimal education in ethics.

1.1 Purpose

The purpose of this report is to aid in the education of ethics. This will be done by providing a web-based game that can be used in an educational environment. **The purpose of the game is to make students think of ethics and not suggest ethical choices.** The goal of the game is to make students reflect on their choices and get a greater picture of how computer science affects ethical matters in everyday life, and what responsibilities come with being a developer.

The game will put the user in the position of an App Store manager who decides

which applications are going to be published on the market or not. Each choice will have consequences for the privacy and contentment of the users and the company's revenue and reputation. The consequences are purely fictional and have no connection to any real-life events.

The target audience of the game is teachers in computer science, as the purpose is to build a game they can use in lectures to have more engaging discussions about ethics in computer science, and what being a developer entails in terms of responsibility. If the purpose is fulfilled, the project will result in a useful application for teachers, where they can easily change the content of the game, which hopefully will result in more ethically aware students and developers.

1.2 Background

This section presents the background of ethics in technology, where it might be lacking, and why it is important to bring more awareness to ethics within computer science.

1.2.1 Lack of Teaching of Ethics in Computer Science Programs

A case study from Europe shows that only two-thirds of the participating institutions integrate ethics into their computer science curriculum [1]. The majority of those who do not include ethics in their curriculum say it is mainly because of lack of time (73%), personnel (73%), and/or staff expertise (50%). Of those who do not include ethics in their education, the majority (61%) find that it is "*important*" or "*very important*" to teach ethics even if they currently are not.

Another analysis showed that ethics are taught in many different contexts and ways, but did not analyze how effective the methods actually were [2]. Whilst the learning goals and learning outcomes differed between courses, there was a general pattern. The general goal was to be able to recognise ethical issues in real life, and then critically reflect on said issues to be able to make well-grounded and nuanced arguments. Sometimes students were taught to put their abstract skills into practical use, for example by applying solutions to problems they have found while doing a critical evaluation. However, abstract abilities could be a challenge for teachers to evaluate.

Although the studies brought up in this report only cover a minority of the current institutions of computer science, with a primary focus on Europe and the US, they all show that there is no general way of "teaching" ethics. They have a lot of variability in the content being taught, which is not necessarily negative, but instead shows that ethics within computer science is a broad field.

1.2.2 Ethical Problems in Technology

A recent study of an algorithm used widely in the US healthcare system shows that it discriminates against black people [6]. The algorithm is used to determine health-care decisions for up to 200 million people each year, meaning that it affects a lot of people's lives. The algorithm gives patients a risk score, which is then used by medical professionals to prioritise patients for various treatments. The study showed that white patients' risk scores were higher than black patients with the same level of illness. Since white people had higher risk scores, they had a higher chance of getting special medical care, such as diabetes treatment and organ transplantations. The reason why white people were given a higher risk score was due to how the algorithm was constructed, namely that it used the payment history of the patients. Since white people historically have had more access to medical care than black people, they have overall spent much more money. Even if the intention was to be fair, the underlying calculations were based on biased data and therefore resulted in a biased algorithm.

Another study shows that social media companies design their platforms with the attention of the user as the product, meaning that the apps are designed to promote addictive behaviour [7]. This can be seen as ethically questionable, as the creators make money from exploiting people and inducing addiction, something that can be seen as harmful to the users. The same study also claims that people with internet addiction, social media addiction included, are the most likely to be suicidal. Additionally, a study in Norway showed that addictive social media use can reflect narcissistic personality traits and an attempt to inhibit or suppress negative self-esteem [8].

1.3 Limitations

The project will both be created by and aimed at university students in computer science and therefore the game will have its limitations. When mentioning ethics in this project, it is referring to ethics within computer science and situations that might occur specifically within that field.

The content of the game is created only with the purpose to act as a placeholder since the creators of this project are students with minimal experience or education in ethics. Therefore, the content should be regarded as a temporary placeholder and will not be a priority during the creation of the game.

1.4 Thesis Outline

What follows in this thesis presents the process of developing the game. Chapter 2 provides the background material and concepts used for this project and related work that gave inspiration. Chapter 3 presents the different methods used during the process, why they were chosen, and how they were applied. Chapter 4 goes more

1. Introduction

in-depth into the process of the project, the different steps, and the continuous development. Chapter 5 presents the final product followed by the final evaluation of the game. In Chapter 6 there is a discussion of the results compared to the expected goals and the final evaluation, together with challenges faced during the development and possible future features. Finally, Chapter 7 provides a conclusion of the project.

2

Theory

Game-based learning and design fiction are two important concepts as to why the creation of a game was chosen to aid in the teaching of ethics in computer science. The concepts will be explained in further detail, and how they were incorporated into the game. This section will also present a guideline of ethics and similar projects, both games and educational frameworks, that inspired this project. The other projects will be briefly described and it will be made clear which parts of them were adapted into this project.

2.1 Game-Based Learning

An active learning technique is game-based learning. This is a teaching method that allows students to become more actively involved and engaged in the class content [4]. Similarly, it has shown that educational computer games can be effective and motivational learning environments within high school computer science [5]. Games can increase both active and effective learning, but it is important that game theory is applied when designing a game [9]. Wangenheim and Shull write that games can allow effective learning in the field of software engineering education. For the student to benefit the most from the game, it should allow learning through for example situated learning. It is also important to note that game-based learning should be complemented with other teaching methods. However, due to the effectiveness of game-based learning and educational computer games, the use of game-based learning could be a suitable educational tool in courses about ethics as well.

2.2 Design Fiction

Design fiction is a technique used in research and interaction design to explore hypothetical scenarios by creating realistic-looking artifacts and media [10]. Design fiction is so common that it is almost standard practice in the field of design and human-computer interaction [11]. The goal is not to focus on the functionality of the design, but to explore possible futures and their implications. This technique has been used to create discursive space around emerging technology and increase political engagement. Using multiple media, designers can represent their design concept, which may influence real-life technology. Design fiction is similar to other approaches that explore the future, such as world-building and speculative design. Design fiction does not aim to convince readers how things should be, but to explore

the implications and values inherent in technologies [10]. This project takes a design fiction approach to discuss ethics in a fictive world.

2.3 ACM Code of Ethics

The Association for Computing Machinery (ACM) formulated a guideline consisting of seven general ethical principles they think every computing professional should follow [12].

The first principle 'Contribute to society and to human well-being, acknowledging that all people are stakeholders in computing', makes a strong emphasis that it is the computing professional's responsibility to use their skills and knowledge to provide for the greater good of society and to prioritise the well-being of every individual that may be affected by the result of their work. In addition to this, the principle encourages computing professionals to partake in pro bono or volunteer work that serves to benefit the public good.

The second principle 'Avoid harm', places emphasis on that computing professionals should take precautions to assure that the results of their work do not cause harm for others. In short, ACM defines 'harm' as all potential negative consequences, especially those with significant or unjust consequences. The principle states that even well-intended actions may lead to harm, and in the case of when it happens, those responsible are obligated to attempt to undo or reduce the harm as much as possible. To avoid or minimise the risk of unintentionally harming someone, computing professionals are advised to follow the generally accepted best practices unless there is an ethical reason that states otherwise.

The third principle 'Be honest and trustworthy', emphasises that computing professionals should be truthful about their qualifications and competence. They should be transparent about their systems' potential shortcomings and limitations as well as avoid the use of any sort of false or fabricated data. Failing to follow guidelines is a clear violation of the ACM Code.

The fourth principle 'Be fair and take action not to discriminate' states that computing professionals should treat all individuals fairly and without prejudice. The fairness brought up in this principle implies that the systems created by computing professionals should not discriminate against anyone, no matter what. Technology should be for and support everyone as far as possible so that no one is oppressed or left out.

The fifth principle 'Respect the work required to produce new ideas, inventions, creative works and computing artifacts' implies that the development of new ideas and technology brings value to society and therefore whoever is responsible should in return gain value from their work. Computing professionals should act with respect toward other developers' ideas and creations, especially those that are copyrighted and patented. Computing professionals are also obliged to give credit when using

others' work.

The sixth principle 'Respect privacy' emphasises the importance of computing professionals respecting privacy. The principle states that this is because technology enables the collection of personal information and other data to be done quickly and efficiently, sometimes with such secrecy that the people affected have no knowledge of it. Computing professionals shall therefore strive to only use personal information for legitimate causes and make it very clear to the individuals affected what of their data is being collected and thoroughly explain how it is going to be used. Computing professionals should only collect the minimum possible amount of personal data that is required by the system and also collect consent before doing so.

The seventh and final principle 'Honor confidentiality' is all about protecting confidential information such as trade secrets, financial information, and research and client data just to name a few. However, there are a few exceptions that computing professionals should be aware of when confidential information goes against the law, organisation regulations, or the ACM Code. In the stated cases, confidential information should only be disclosed to the appropriate authorities.

2.4 Related Games

This section will present applications that inspired the game. These applications influenced the core game loop, some design elements and how different choices lead to different outcomes in the game. The games were suggested as inspiration by one of the supervisors.

2.4.1 Papers, Please

The game idea takes great influence from the computer game Papers, Please. Papers, Please [13] puts the player in the role of an immigration officer in the fictional dictatorship Arstotzka. Their task is to check people's documents and decide whether they are permitted into the country or not. If the player makes a mistake their family will be punished and after enough violations, the player will lose the game. However, there are ethical conflicts where a rewarding decision for the player has negative consequences for a character in the game and vice versa.

The need to balance various factors to succeed was incorporated into the game idea of this project. The player having the role of an employee with authority over people's lives and making decisions was also adapted into the game.

2.4.2 Reigns

Reigns is a strategy video game developed by Nerial and published by Devolver Digital [14]. The player is a medieval monarch and will decide how to act in various situations coming up in the game. Each decision affects four different factors. Before making a decision, indicators are shown above the factors that would be affected,

2. Theory

see in figure 2.1. The goal of the game is to balance all factors while trying to reign as long as possible.



Figure 2.1: A screenshot from the game *Reigns* which heavily inspired this project.

The usage of four factors was incorporated into the game of this project, as well as the indicators before the user makes a decision. The placement of visual elements was also adapted, such as using a card to display information at the center of the screen, putting factors at the top center, and indicators as dots above the factors.

2.4.3 Moral Machine

Moral Machine is an online serious game that collects data on how citizens would want autonomous vehicles to solve moral dilemmas in the context of unavoidable accidents [15]. The platform exists for two purposes; to create a common picture of human opinion on how machines should make decisions when faced with moral dilemmas and create a discussion about potential scenarios of moral consequence [16]. The application gives the user moral dilemmas and collects information on the decisions that the users make. Later, the choices of all users are presented and contrasted with the current user's choices.

The way Moral Machine puts the user in moral dilemmas was something that inspired the game idea of this project, by giving the user an example of moral dilemmas and making decisions that come with consequences.

2.4.4 Detroit Become Human

Detroit Become Human is a video game in which you primarily play as an android named Connor [17]. In this universe, technology has advanced immensely and androids look and behave almost like humans. In addition to playing as Connor,

you also play as two other androids named Kara and Markus. Each of these three characters has its own unique storyline and perspective. The game explores the relationship between androids and humans in which the player has to make moral decisions and choices that change the course of the game's narrative. Playing as an android presents two questions; will the player control the android as if it were a human? Or will the player control the Android, based on what it thinks is the Android's programming? This places the player in a position to make moral choices under pressure to progress in the game. According to [18] which made a case study about moral decisions in Detroit Become Human, players were more likely to act in a positive manner when presented with moral decisions under stressful moments in the game.

2.5 Related Work

Critically Conscious Computing [19] is an online book created by Amy Ko et al. The book has the purpose to develop both computer science teachers' and students' understanding of how to teach and learn computer science through the lens of social responsibility [20]. The authors hope to encourage an equitable and culturally sustaining future of computing. This online book is only available as a website, making it free of charge, free from royalties and hidden motives [19]. It is made to be a community resource and can frequently change in response to feedback and new resources. These things make the book an unconventional method to awaken students' critical consciousness to the systems, structures, and ideas of computer science that constrain them. This method of providing a framework for teaching consciousness and ethics is different from the one pursued in this project. However, some similarities are shown in the target group, teachers and students within computer science, and the purpose of awakening students' consciousness and giving thoughts regarding ethics within the field of computer science. The project also states that it is important to show both the risks and possibilities with technology, which is why this project will have both negative and positive outcomes for each decision.

Project ImpactCS is a project that was created in the 1990s to define the core content and pedagogical objectives for integrating social impact and ethics into the computer science curriculum [21]. The project was created due to the rapidly advancing of computer science and the need to include the social, ethical and professional context into the discipline. To create the framework, the project had people working with ethics from both philosophy and theology, historians, social analysts, sociologists, anthropologists, and psychologists to research the area. Even though computer science has evolved greatly since Project ImpactCS began, the need for integrating social impact and ethics in computer science education is still relevant. This was kept in mind during the process of this project, that the ethics content should be created with people working in the field of ethics, similarly to in Project ImpactCS.

The bachelor's project App Store: The Game was created by students in 2022 as well. A game was created using the game engine Unity and the player got to deal

2. Theory

with ethical dilemmas by reviewing potential applications that are to be sold at the App Store. ACM Code of Ethics was used as a foundation for the aspects of ethical teaching. The 2022 project successfully created a game as a bridge between teaching ethics and the computer science field but failed to make the game engaging to play [22]. Although the differences in both the processes and outcomes between the 2022 project and this, this project took a starting point in the 2022 bachelor's project and aimed to continue the work for increased awareness of ethics in the field of computer science.

3

Method

This chapter presents the methods used during the process of the implementation and development of this project, and how and why they were used. Many of the methods and tools that will be covered here were mainly chosen because of how they facilitate the work and structure both before the implementation and during development.

3.1 Implementation Tools

This section describes the tools used for the implementation process of the game. It goes into detail about what the tools were used for, how they were used, and why they were chosen.

3.1.1 Figma

Figma was used to design the website before it was implemented. Figma is a collaborative tool for interface design that can be used to create websites, logos, or any type of digital design [23]. Early in the design process, FigJam was used to create sketches, storyboards, and low-fidelity prototypes. FigJam is a collaborative digital whiteboard created as an additional tool by Figma. The tool is used for brainstorming and is suitable in the early stage of the design process. Later in the design process, Figma was used to create high-fidelity prototypes of the final product. It supports interactive prototypes and is suitable for testing before implementation. This way, constructive criticism could be received before implementing the product and thus saving a lot of development time.

3.1.2 NextJS with TypeScript

The method used to implement this project was a tech-stack using ReactJS, but with TypeScript. This way, the app was easy to use on all platforms and devices since it was on a website. Furthermore, NextJS was used as a framework for the project [24]. NextJS is a full-stack framework that enables server-side rendering, unlike the traditional client-side rendering that is found in ReactJS. Server-side rendering significantly shortens page loading times. Furthermore, TailwindCSS was used to style components and objects since it is a massive library with thousands of pre-defined css-classes. This tech-stack enables out-of-the-box development without having to extensively set up different software shortening development time and

increasing accessibility immensely. Normally, NextJS is used with JavaScript but since NextJS also has support for TypeScript, the latter was chosen. The only major difference between JavaScript and TypeScript is that TypeScript has types whereas JavaScript does not. This increases code-readability and enables static type checking. Vercel is a native NextJS continuous integration platform that maintains NextJS and is designed to enhance the experience. This platform was used to deploy the application to a website that is accessible to all.

3.1.3 GitHub

GitHub was used as a tool for version control and collaborative software development [25]. The codebase was stored as a repository for easy access between devices. GitHub has several different features such as tools for code review, issue tracking and project management. By submitting pull requests and issues, other developers can review and continue development on the project. When creating a new feature, a new branch is created to prevent conflicts under the development of the same file. To merge with the rest of the codebase, a pull request was created for other developers to review and accept if the merged code is up to standards. GitHub can also be integrated with several other services such as continuous integration and development platform. The group set certain standards for when using Git. These standards included a restriction on at least one approval on a pull request before merging to the main branch, no committing code directly to the main branch, and certain name standards when creating new branches. These standards were set to achieve a high quality project and to keep everybody updated on which features or fixes have been made, and it is always beneficial to have the approval of someone else.

3.2 Development Methods and Tools

This section presents the methods and tools used to achieve the best possible workflow and structure for creating the game. Another important part of the development was testing and evaluations of the game, which is also described here.

3.2.1 Agile Management

To work agile means to develop a project through frequent small releases with continuous improvement, and a specific tool for this is Scrum [26]. This tool helps to manage and structure the work for a team and divide the tasks into smaller problems with their respective priorities. As for this project, there were plenty of iterations to be made to create a game from scratch.

When using Scrum there are many different ways and extra tools to use to visually keep track of and structure the work between team members. In this project, Trello was used as an additional tool for that purpose [27]. In Trello, there is a backlog where each task is created as a card that can contain respective information and requirements. It is also possible to assign team members to cards so that everyone

can see who is responsible for which task. To structure the backlog, there are different lists where the cards can be placed. This is how all team members could check the status of each task and the project in general, see figure 3.1.

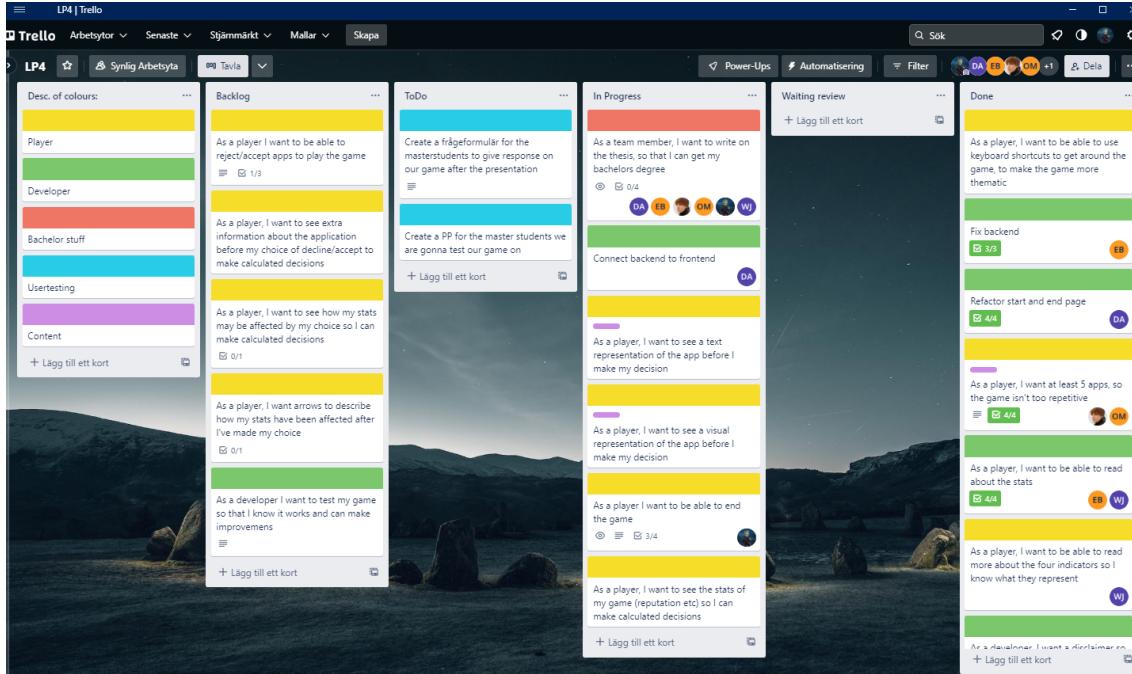


Figure 3.1: A snapshot of the Trello board for this project in Study period 4.

In alignment with Scrum standards, the team had weekly meetings where all team members planned the week, discussed the progress, and any problems that were to be solved. Stand-ups, which are short meetings of 15 minutes, can be useful when no meetings are planned but someone in the team wants to update everybody on the status of their assignment or if there are any problems.

3.2.2 Design Process

The game was created, prototyped, tested, and iterated during the design process. The process was a repeated cycle and involved designing, evaluating, and redesigning. To achieve a user-centered design, the process was inspired by [28].

To ensure a user-centered design the design process followed the double diamond design, see figure 3.2. It is a method that involves users throughout development. The method has four different phases that are iterated. The four phases are *discover*, *define*, *develop* and *deliver*.

3. Method

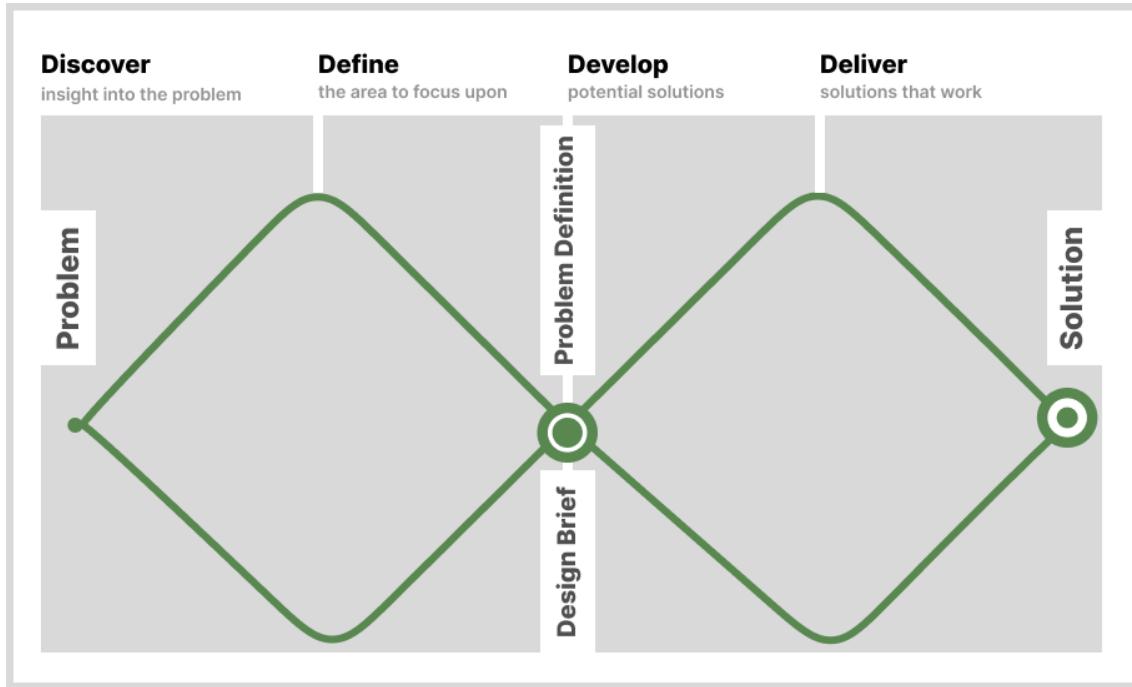


Figure 3.2: Image that visually displays the double diamond of design.

The left side of the double diamond design involves discovering requirements. This includes mapping out the target audience and gathering data to define what will be developed within the project. The development phase involves proposing ideas that will meet the identified requirements. These ideas can show through prototypes, sketches, and alternative drafts. In this phase, both low- and high-fidelity prototypes are developed to get a sense of how it will be to interact with the real product. Additionally, the development phase includes evaluation. This is an important part of the design process, that will determine usability and give valuable insights [28].

Overall, this method is not linear and the phases will be iterated continually. The design process will contain design, evaluation, redesign, trial and error and round again with a new perception.

A MoSCoW was created before building prototypes to help define the parts of the game needed. This in turn helped later determine what had to be done for the game to be considered complete, which also helped in deciding what features need to be tested in our different prototypes. A MoSCoW is a method for UX design where the features of a product are divided into four categories; *Must-have*, *Should-have*, *Could-have* and *Won't-have*. The method is effective when prioritising requirements in a project with a fixed deadline. The category *Must-have* are the requirements that the project must have in order to not fail, it can be compared to a Minimum Viable Product. *Should-have* are the requirements that are not completely necessary for the project to be successful, which means that they are not as time critical as in *Must Have*. *Could-have* are the requirements that are not important for the delivery of the project, they are additional things that could improve a better user experience and could be seen as features to be implemented in a future release. *Won't-have*

contains the requirements that are not going to be implemented [29].

After creating the MoSCoW, the next step in the design process was to create several low-fidelity prototypes of the game. The prototype is not supposed to look like the final game, and will instead explore ideas and designs of the game. Early in the design process the digital whiteboard FigJam was used, mainly because it is easy and quick to create sketches and visualise thoughts. A storyboard was made to define the purpose of the game.

The last step in the design process was to create a high-fidelity prototype. The prototype has some functionality, is interactive and looks like the final game. It is suitable to use the web application Figma to create a high-fidelity prototype with interactive elements, see section 3.1.1. Later in the process, the final game was created by using React and TypeScript as the implementation rules explained in section 3.1.

3.2.3 User and Usability Testing

Different sorts of evaluations were conducted during the design process. Tests were necessary during the whole process to be able to analyze the users' experience of the game. The types of methods used for user and usability testing were opportunistic evaluation, formative evaluation, summative evaluation, semi-structured interviews, and questionnaires. This section will explain these terms just mentioned.

Opportunistic evaluation is used in an early stage of the design process. The evaluation has the purpose of providing designers feedback on the design idea early [28]. The feedback is valuable at this stage of the design process because it will give guidelines on what to continue to develop. Opportunistic evaluation is informal and is a quick way of testing the prototype on the target group. The think-aloud method is suitable when this evaluation is conducted, meaning the user is asked to speak their thoughts aloud while performing a task such as testing a prototype [30].

Formative evaluation is used to see if a product reached the user requirements and informs the design process. This evaluation can be conducted whenever in the design process and involves testing and changing the product in parallel. When a design process has several iterations and redesigns, formative evaluation is well-suited [31]. The evaluation can be both qualitative and quantitative. In this project, a qualitative approach was applied because of the nature of the evaluation. The think-aloud method was used in addition to qualitative questions due to the importance of getting direct opinions from the test persons.

Summative evaluation is used to see if the final product was successful. This is used late in the design process or when a redesign has been completed. This evaluation can be used to refine existing requirements or find new features for a future release. Furthermore, the evaluation will give the big picture and assess the overall experience of a product [31]. The evaluation can be both qualitative and quantita-

3. Method

tive. However, in this project, a quantitative approach was mainly applied due to the comprehensive account of user insights and performance being measured.

A semi-structured interview has both open and closed questions. This method of interviewing gives rich insight due to the follow-up questions. The interviewer can ask the interviewee to elaborate and gain complex information. Semi-structured interviews with prepared questions were used during the opportunistic and formative evaluation [28].

Questionnaires are a practical way of getting a large number of participants in a study. To benefit from the questionnaire, it is important that the questions within are specific. The questions can be open or closed as well as qualitative or quantitative [28]. The method is appropriate when the summative evaluation is made, due to a large amount of participants. This method was used in the final evaluation due to the many test persons.

4

Development

This chapter presents the process and different stages of the project, from the beginning until the finished product. This includes how the game idea was formed and its purpose for the project, how the design was refined through multiple iterations of designs and evaluations, and the different stages of the prototypes. It also presents the structure of the code and why certain decisions were made to have a well-structured code. The entire project builds upon the game idea, and therefore it is necessary for it to be clear and well-formed.

4.1 Design Process

The design process was based on a few iterations of the same process: defining MoSCoW, making a prototype in Figma based on MoSCoW, and evaluating the prototype on test subjects. The MoSCoW was adjusted after the feedback was received, and a next prototype was created and tested, as demonstrated in 4.1.

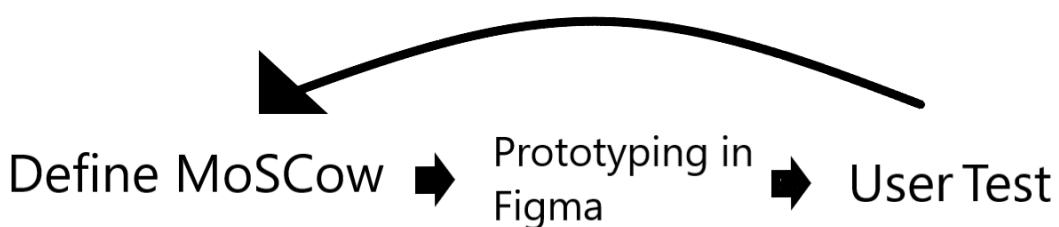


Figure 4.1: Visual representation of the first few design iterations.

When a final high-fidelity prototype was finished and evaluated, the last iteration started, which involved coding the final prototype, instead of designing in Figma, and then a thorough final evaluation was performed, see figure 4.2.

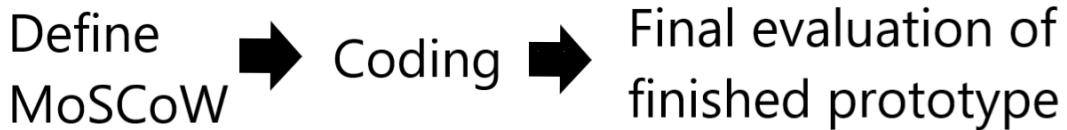


Figure 4.2: Visual representation of the final design process.

4.2 Game Idea

This section describes the development of the game idea, what parts of the initial idea remained up until the finished product, and presents the final core gameplay loop.

4.2.1 Development of the Idea

The initial idea of presenting the user with an application and the option to accept or decline the app was never changed, as this was considered a good and easy way to put the user in the role of an App Store employee. This remained the core idea up until the finished product. The main difficulty, however, came with presenting the consequences of the user's choice. It was discussed whether the consequences should be presented in numbers, text, or both, and it ended up becoming a combination of the two. Throughout the prototypes shown in section 4.4, the idea of indicators was developed and refined. The indicators and the consequences are only loosely connected to ACM Codes of Ethics since the main focus was not put on the creation of content.

4.2.2 Finished Game Idea

In the game, the player has the role of an App Store manager. The player starts the day by opening up the terminal, a command line interpreter, login and start reviewing submitted applications. To help the player with the reviewing process, there is a text and image of the submitted application. The main task of the player is to accept or decline applications while balancing four different indicators: reputation, contentment, privacy, and revenue. Reputation is defined by the public's perception of the App Store and how it operates. Contentment is defined by the happiness and satisfaction of the App Store users. Privacy is defined by the level of privacy protection the user has while using the company's applications. Revenue is

defined by the profit and total earnings of the App Store. After the application is approved or declined, the player is presented with the consequences of the launch of the application and how the indicators are affected. If at least one of the four indicators reaches zero, the game ends and the player's employment at the app store company is terminated. If the player manages to endure the day without dropping any of the indicators to zero, the player wins and the game ends.

4.2.3 Disclaimer

When the game starts, the player is met with an introduction to the game followed by a disclaimer. The need for a disclaimer emerged during the second pilot study where test subjects considered the content biased, see section 4.5.2. It was added to clarify that the content is indeed inevitably biased and made by students who are not educated in ethics.

4.2.4 Game Mechanics

The game supports both click and point, as well as keyboard controls. Click and point controls mean that the game has mouse support and the player can click all the buttons. Keyboard controls mean that the game supports predefined shortcuts.

4.2.5 Design Theme

The player should get the feeling of being in the inner workings of the App Store, such as a back office. The idea of the design theme is inspired by the graphical interface of the terminal, see figure 4.3. The text in the game has the font Roboto Mono, the background is black and the text is white similar to the terminal. Shortcuts for actions in the game are added to enhance the experience of working with computers.

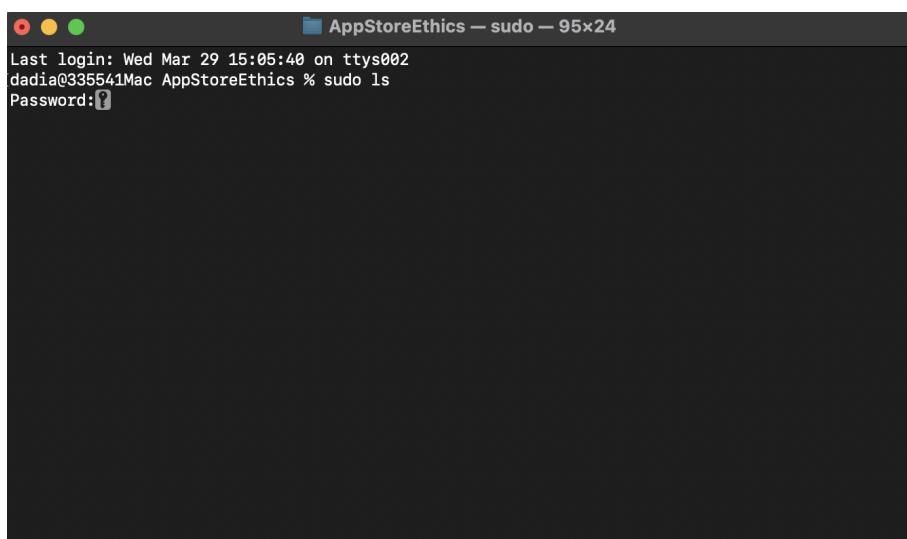


Figure 4.3: Image of a terminal on a MacBook Pro.

The design theme has the purpose of being customised to the target group. This is

shown on the first page where the text is animated and visualised as in the terminal. The thought behind this is that the design should be designed for the target group, students within computer science, and give a reference to the terminal or command prompt aesthetics.

4.2.6 Development of Example Applications

Five fictional applications were created to provide the game with content. These five applications were loosely based on existing applications, and some potential ethical consequences of declining or releasing these applications were then created. The principles of the ACM Code of Ethics provided some inspiration for the consequences, such as avoiding to do harm and respecting users' privacy. Since design fiction is being practised in this project, the content was mainly made to explore the game for encouraging discussions about ethics in computer science education. The example apps were made to feel authentic and have fictional ethical consequences, but they fill the role of provocative placeholders more than anything else. This way, the concept, along with its limitations and possibilities, could be fully explored.

4.3 Design Development

This section presents the development that led to the finished design of the game. Requirements, prototypes, and evaluations are described and elaborated. The design development was an iterative process, where requirements and prototypes were changed continuously.

4.3.1 MoSCoW

After finishing the game idea, a MoSCoW was made to prioritise the features of the game. As seen in figure 4.4, the features are prioritised in categories such as Must-have, Should-have, Could-have, and Won't-have. The creation of a MoSCoW was a part of the *Define* phase in the design process, described in section 3.2.2, and narrowed down the features to focus upon. Moreover, this method of ranking requirements was helpful when later implementing the game and creating user stories.

Moscow	Must Have	Should Have	Could Have	Won't Have
Fitting to the audience and setting Oliva	Give the users food for thought Alice Blackart	At least five apps to judge Julie Blackart	Between 6-10 apps to judge David Anderson	Optional tutorial Emilia Berger
Make the choices of accept/reject apps have consequences that are immediately shown to the player Emilia Berger	Possibility to make choices (accept/reject app) Oliva	Disclaimer Oliva	Purpose Staff	Create new apps Staff
Make the user understand how choices in design of apps have real-life consequences Emilia Berger	Ending page Emilia Berger	Start page Oliva	Hints on first round Oliva	Evil mode Oliva
Clickable cards to show more info about the apps Julia Blackart	Four symbols representing Reputation, Contentment, Privacy, Revenue Oliva	Give indication of which symbols are affected by the player's choice to accept or reject Emilia Berger	Keyboard shortcuts Oliva	Comment section to help reflect consequences Woo
Card that shows text information about app Oliva	Card that shows visual information about app Oliva		More apps Woo	Short story: Start to end Staff

Figure 4.4: Notes from the projects' MoSCoW.

4.4 Prototypes

Three finalised prototypes were made. However, several components and smaller prototypes were created in each iteration. This section presents the prototypes, from initial design up until the last high-fidelity prototype, and the design choices with the highest importance to the design process.

Hereafter, Prototype 1 is defined as a low-fidelity prototype, Prototype 2 is defined as the first high-fidelity prototype and Prototype 3 is defined as a second high-fidelity prototype. The final result will be presented in section 5.1.

4.4.1 Prototype 1: Low-fidelity

Prototype 1 was created with the digital whiteboard FigJam and had limited navigation. The low-fidelity prototype did not need to look like the final game because the purpose was to visualise ideas and explore the design of the game. This prototype contained a starting page with information about the game, two example applications, and an ending page. The player could accept or reject the two applications and see the consequences of each decision. A bar of people was included on the page of consequences, see figure 4.7, as a representation of how many users have been positively or negatively affected by the player's decisions. The bar starts off full and can decrease or increase during the game.

4. Development



Figure 4.5: Prototype 1: Starting page with introduction.

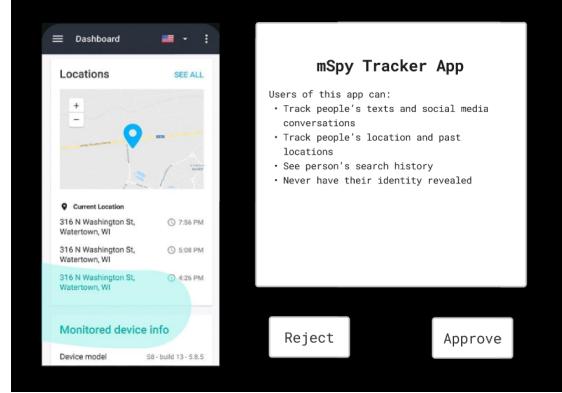


Figure 4.6: Prototype 1: Application page.



Figure 4.7: Prototype 1: Consequence page when approving an application.



Figure 4.8: Prototype 1: Consequence page when rejecting an application.

The starting page, as seen in figure 4.5, is supposed to have the aesthetic as the terminal to give the user the feeling of the theme. The application page, as seen in figure 4.6, has a text and visual representation of an example application. Figures 4.7 and 4.8 shows the consequence pages. The pages were supposed to be a bit provocative and use potential users as a measurement so that the players will reflect on their choices.

4.4.2 Prototype 2: High-fidelity

Prototype 2 was created using Figma and has the nature of a high-fidelity prototype. The prototype has functionality, such as navigation, is interactive and looks like the final game. This prototype evolved from the evaluation of Prototype 1, the result of the evaluation can be found in section 4.5.1. The major changes were adding four indicators to the game (reputation, contentment, privacy, revenue), which came to replace the bar of people in figure 4.7. The four indicators are located at the top of the page and can be seen in figures 4.9 and 4.10. These indicators, as well as the placement of the flashcard, are greatly inspired by the game Reigns, see section 2.4.2. In figures 4.11 and 4.12 the indicators change their value depending on accepting or declining the example application. Colours and arrows were added to clearly show the player the change of the indicators. Additionally, each of the text

consequences got a related indicator to show the player which of the indicators gets affected by their choice.

The new indicators made the game more complex. Therefore, an optional tutorial walking the player through the game was added. The tutorial's purpose was to give the player more information and instructions on how to play the game. A flashcard with a visual and textual representation of the example application was added. When clicking on the flashcard, the card would flip and show the other side. This was made because the prototype lacked pliancy. The creation of fictional applications, such as in figure 4.6, was not prioritised during the design of the high-fidelity prototypes.

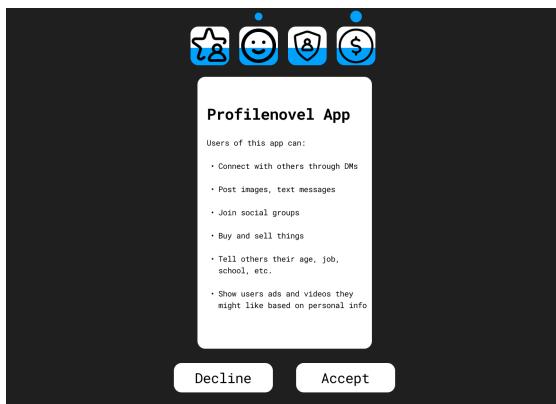


Figure 4.9: Prototype 2: Flashcard with a text representation of example application.

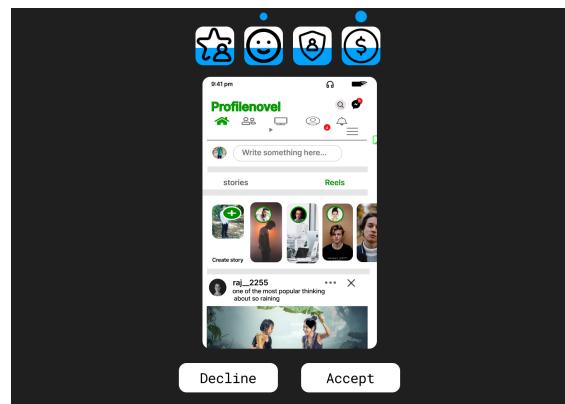


Figure 4.10: Prototype 2: Flashcard with a visual representation of example application.

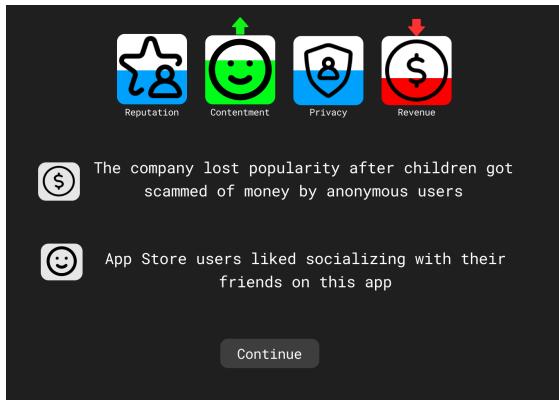


Figure 4.11: Prototype 2: Page showing indicators changing and its corresponding consequences when accepting example application.

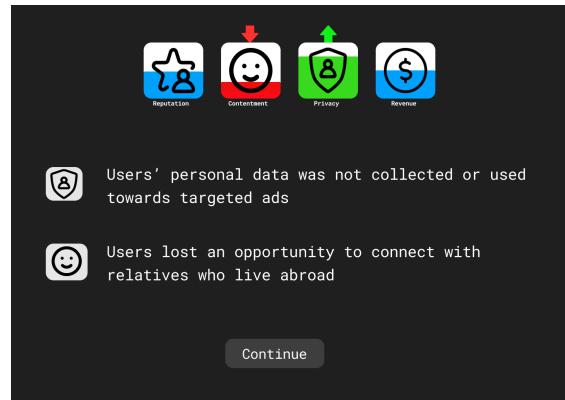


Figure 4.12: Prototype 2: Page showing indicators changing and its corresponding consequences when declining example application.

4.4.3 Prototype 3: High-fidelity

Prototype 3 was created using Figma and has the nature of a high-fidelity prototype. The prototype evolved from the evaluation of Prototype 2, the result of the evaluation can be found in section 4.5.2. Prototype 3 is briefly explained due to the similarities between Prototype 2 and the final game. The main changes were to add pliancy to the main flashcard and buttons, add hints on how to play the game, add an explanation of indicators and include a disclaimer. The creation of fictional applications and consequences were not prioritised during the design of Prototype 3. The tutorial made in Prototype 2 is not included in Prototype 3. Prototype 3 had essential instructions and hints on how to play the game, so a tutorial is not necessary for the final game. Lastly, two different end pages are included in Prototype 3.

4.5 Pilot Studies

This section presents the structure, results and changes made from the two evaluations. The final evaluation is presented in section 5.2.

4.5.1 Pilot Study of Prototype 1

The first evaluation was made when Prototype 1 was finalised. The evaluation had the characteristics of an opportunistic evaluation, for more context see section 3.2.3. The purpose was to receive feedback on the idea from potential users. Therefore, the evaluation was informal and the test subjects were urged to think aloud during the test. This method was used due to the importance of receiving real and honest thoughts from the test subjects.

The test group consisted of five people from the target group. Three of them were students in Software Engineering at Chalmers and two were students in Computer Science at the University of Gothenburg. The test subjects were asked to go through all pages of the prototype using the think-aloud method.

Lastly, the test subjects were interviewed, and asked four questions:

1. Could you learn about ethics in computer science in this way? Do you think it is suitable to use in a classroom?
2. How real do the consequences of rejecting and approving the applications feel?
3. Do you think the scenarios are realistic?
4. Anything else you would like to add?

The test group were cautiously optimistic about the first question. Most of them thought that the game was a suitable tool for learning ethics and would make in-class learning more enjoyable. For a more detailed response, see Appendix A.

The evaluation resulted in six key points. These keynotes were important for the construction of Prototype 2. Things to change, delete, add or adjust in the upcoming prototype, Prototype 2:

- Change the factors of people/users. Add more information about what they mean for the game.
- Add an explanation of the game so that users will understand what to do.
- Refine application example and consequences.

The things to keep or enhance in the upcoming prototype, were the game idea, theme and aesthetics of the game, and the navigation.

4.5.2 Pilot Study of Prototype 2

The second evaluation was made when Prototype 2 was finalised. The evaluation had the characteristics of both an opportunistic and a formative evaluation. Prototype 2 consisted of new features and improved existing features/requirements. Therefore, the evaluation had a combination of two sorts of characteristics. The purpose was to evaluate the changes made from the first evaluation and to investigate if Prototype 2 had reached the user requirements. A qualitative approach was carried out in combination with the Think-Aloud method.

The test group consisted of six persons from the target group, similar to the first evaluation. The test was conducted so that the test subjects would play the game, give their thoughts and ask questions if needed. Lastly, the following questions were asked verbally of the test subjects:

1. Could you learn about ethics in computer science in this way? Do you think it is suitable to use in a classroom?
2. Did you understand the dots above the symbols?
3. Do you understand the symbols?
4. How realistic do the consequences feel of the decisions?
5. Anything else you would like to add?

Four out of six said yes to the first question and said that they think this is a suitable tool for including ethics in a classroom. For a more detailed response, see Appendix B.

The evaluation resulted in nine main takeaways. These keynotes were important for the construction of Prototype 3. Things that were concluded to change, delete, add or adjust in the upcoming Prototype 3:

- Explain the four indicators, Reputation, Contentment, Privacy, and Revenue better.
- Improve description of example applications.
- Add pliancy to the main flashcard and buttons.

- Add hints on how to play the game.
- Add disclaimer.

The things to keep in the upcoming prototype, were the four indicators, the aesthetics and game theme, the platform, and the hinting dots above the indicators.

4.6 Implementation

The final product is a web-based NextJS React application. The game is web-based because it makes it fast and easy to access, ideal in a classroom situation. No data is stored between games and all data during the game, such as values of the indicators, are stored in variables at runtime that get removed automatically when the client closes the game. At the beginning of development, a coding standard was created for good practice, such as commenting when necessary and writing the code so that it is easily extendable. The following sections describe the implementation of the front-end and back-end and how they are connected.

4.6.1 Pages and Components

The game uses NextJS pages to switch between stages of the game loop. Each page has its own content in a file, which makes it easy to add new pages and content. The pages are navigated between using a router, and redirecting the user when they perform a certain action or a certain event happens. For example, if the player is on the game page and the game is over, the end page is loaded instead.

```
const router = useRouter();

if (app.isFinished()) {
  console.log('game ended');
  router.push('/endPage');
}
```

Figure 4.13: A screenshot of the code which redirects the player to the end page if the game is finished.

As seen in figure 4.13, the code for redirecting a player is compact and easily implemented.

There is a total amount of five pages:

- The start page of the game
- Game page where the player can accept or decline an app
- Consequence page
- End of game
- Credits

The content of each page is built up by React Components [32]. The components are implemented as functions rather than classes, as recommended by React's official documentation. A component can be described as a frame for something that can be reused multiple times. An example of a component in the project is the *GameIcon* component that contains an image and a background colour of a defined height. All *GameIcons* take in a name of a stat and its value to determine which picture to display and the height of the background colour (along with some information for the graphical display).

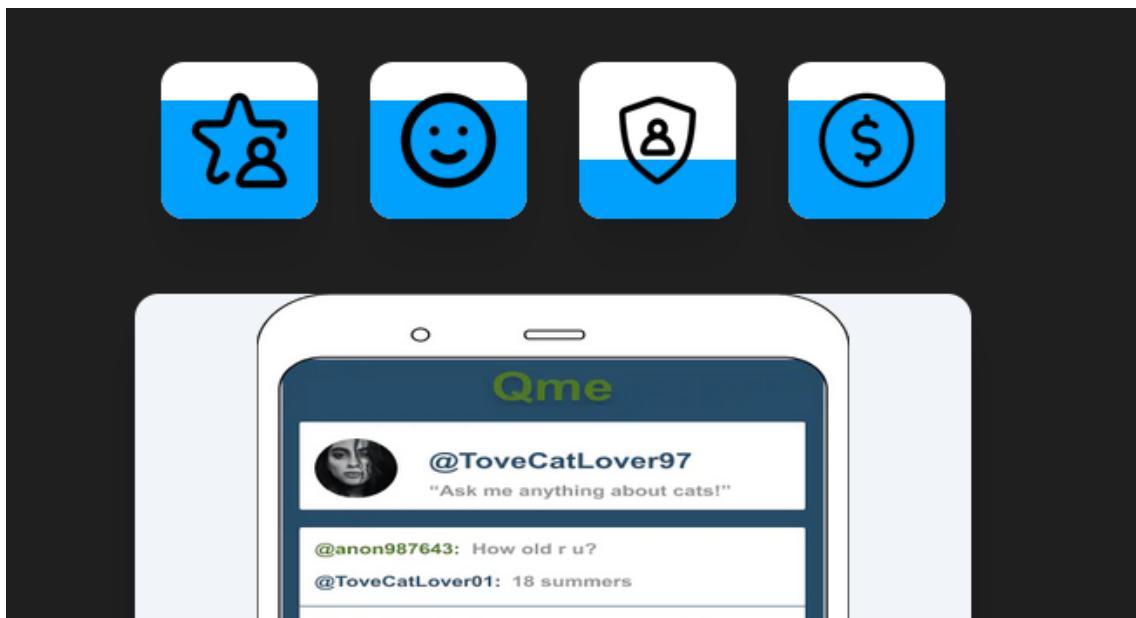


Figure 4.14: Four examples of the component *GameIcon*.

The four *GameIcons* in figure 4.14 are themselves part of a component called *AppIndicators*, which also contains a dot for each of the four *GameIcons*. Figure 4.15 contains a snapshot of the code to see the structure.

```

<div className="flex flex-col">
    <Dot size={changeRep} />
    <GameIcon iconName={"reputation"} progressValue={reputationValue} appInd={true}>
</div>
<div className="flex flex-col">
    <Dot size={changeCont}>
        <GameIcon iconName={"contentment"} progressValue={contentmentValue}>
</div>
<div className="flex flex-col">
    <Dot size={changePriv}>
        <GameIcon iconName={"privacy"} progressValue={privacyValue} appInd={true}>
</div>
<div className="flex flex-col">
    <Dot size={changeRevenue}>
        <GameIcon iconName={"revenue"} progressValue={revenueValue} appInd={true}>
</div>

```

Figure 4.15: A snapshot of the component AppIndicators.

Other examples of content that is built up by components are buttons, app descriptions and app consequences. Using components and grids in the CSS allows new visual elements to easily be added to the pages. Since the game contains a lot of similar visual elements, using components also enabled valuable code reusability.

4.6.2 Backend

The backend is written in TypeScript. All applications are stored in an array using a TypeScript interface for data storage. Interfaces can store a lot of data while still easily readable and updated, which is suitable since all applications contain a lot of information. The backend also contains player information and game logic for when the game is won, lost, or should continue. The code is written to be easily extendable and type-safe, using immutability when possible. TypeScript was chosen for type safety and because it is the same language as the frontend. To maximise type safety, all variables and methods are type-annotated. The backend contains some code duplication that was not removed due to lack of time.

The backend consists of two interfaces, a class for the player's data and a function that initialises the contents of all apps. The interface *IApp* is used to store data for an app: a title, description, and consequences for accepting and declining the app. The interface *IConsequence* is used to describe a consequence with a text and how it affects the stats of the player (reputation, contentment, privacy, and revenue). *IApp* contains two lists of *IConsequence* where the consequences of the first list happen if the player accepts the app and the consequences of the second list happen if the player declines the app.

The class *playerData* contains all data for a game session and logic to update the state of the game. *playerData* uses a singleton pattern to be certain that only one

instance of the game is created at a time. When the game ends a new instance is created. The data of the class is stored in global variables:

- The value of all stats ranging from 0-100
- The current state of the game (in progress, won or lost) represented by an enum
- The current app
- An array containing the remaining applications
- The lastly made decision, represented by an enum

At the start of the game, all applications are created and shuffled and all values of stats are set to default. The player can hover over the accept and decline buttons to see what stats would be affected by that choice. This is calculated by the method *getChange(decision: Decision)* which loops through the list of consequences and returns a quadruple of the total change of all four stats. When the player makes a decision, the values of the stats are updated accordingly to the consequences of that app and decision. This is done by the method *updateStats(decision: Decision)* which calculates and sets the new value of each stat. The method *nextApp()* pops the array and sets the popped app to be the current app.

The current state of the game is calculated by the method *setGameState()*. If any of the stats are zero or lower, the current game state is set to *lost* and the *reason* why (lose_revenue, lose_contentment etc). If the list of applications is empty, the game state is set to *won*. The method *isFinished()* calculates if the GameState is anything but in progress, meaning the game should end.

4.6.3 Connection Between Backend and Frontend

The frontend has as little logic as possible, simply calling methods from the backend to get information about what to display and when to switch pages. This is to maximize modularity, although there are a few exceptions where separation could not easily be implemented.

The project uses the React state variables to re-render pages; in other words, changes the content of a page when necessary [33]. An example from the project is the state variable *flip*. *flip* is a boolean that determines if the player sees the image or the text description of an app. Here is what it looks like in code:

```
const [flip, setFlip] = useState(false);
```

useState(false) sets the initial value of *flip* to false. Whenever the function *setFlip* is called, *flip* is set to the value of its argument and the page is re-rendered. When the player clicks the image or text description of an app, *setFlip(!flip)* is called. Since the value of *flip* is changed, the web page displays the opposite side of the card with an animation.

4. Development

The methods of the backend that calculates the state of the game and the player's values are called when loading pages or the player is clicking a certain button (using onClick). For example, to update the value of stats when the player has made a decision, *updateStats(ACCEPT)* is called if they click the accept-button and *updateStats(DECLINE)* if they click the decline-button. Another example is when the game page is loaded, the method *isFinished()* is called and changes the page to the ending page if the method returns true.

5

Results

This chapter presents the looks and features of the final version. Additionally, the results of the final evaluation from a group of master's students in computer science, who tested the game and gave feedback on it.

5.1 Final Product

The final game has five pages. Each page will be described with its content and how it connects to other pages.

5.1.1 Start Page

The start page gives an introduction to the game and brief instructions on how to play the game, as seen in figure 5.1.

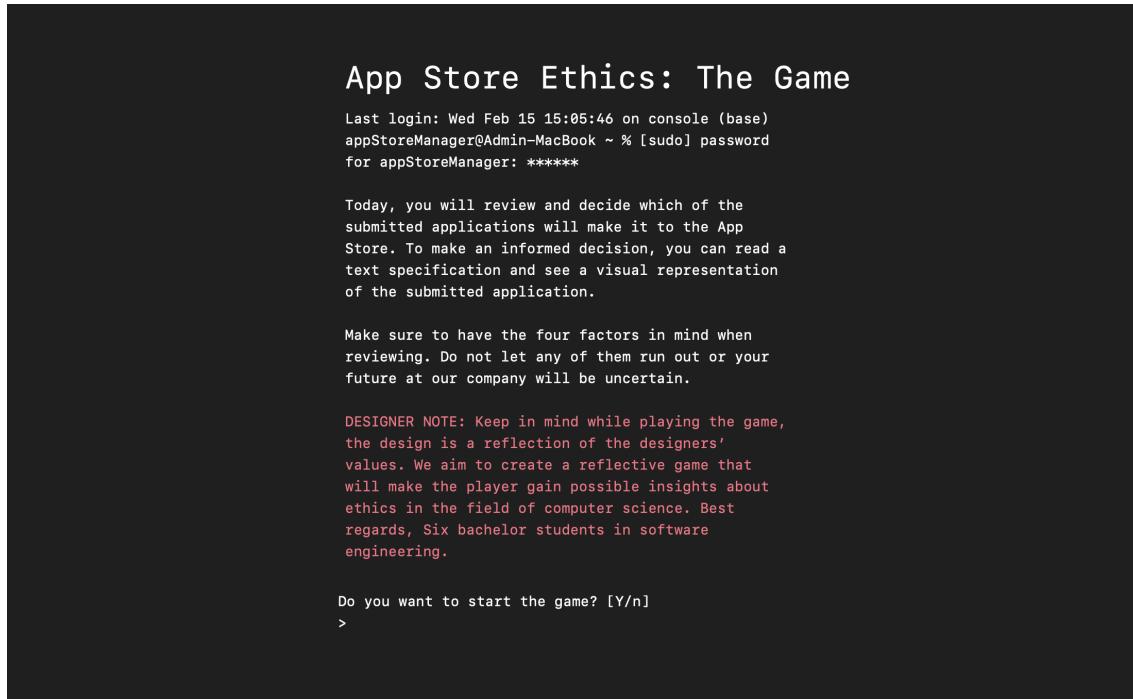


Figure 5.1: Final game: The starting page of the game.

The text on the start page is animated as in a terminal. Lastly, the disclaimer is presented before the player can start the game. The start page includes the user

5. Results

feedback from the evaluations regarding more information on how to play the game and that the game could introduce bias from the designers. The disclaimer is an important part of the game and is in red colour to attract the attention of the user.

5.1.2 Game Page

The game page can be seen in figure 5.2. The page consists of a flashcard with a visual and textual representation of the example application, four indicators, two buttons for accepting or declining applications, and a popup window.

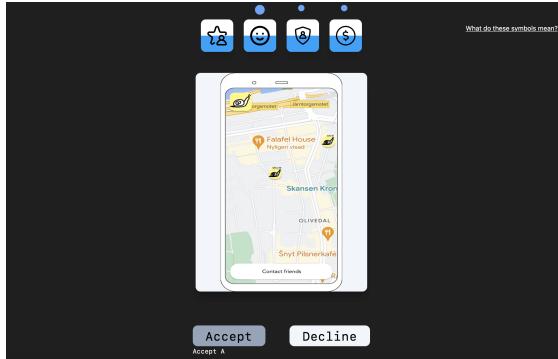


Figure 5.2: Final game: The game page with example applications, indicators and accept and decline buttons.

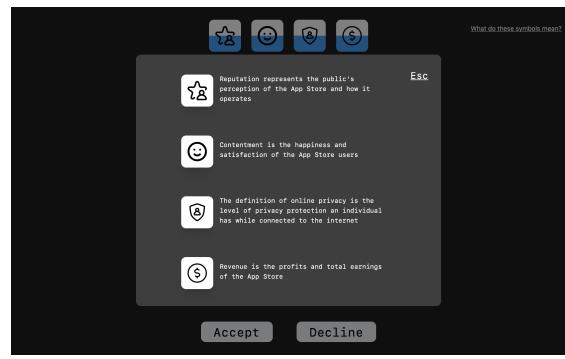


Figure 5.3: Final game: Popup page that can be found when clicking at "What do these symbols mean?".

5.1.3 Consequence Page

The consequence page is shown after the player reviewed the application. The page consists of the four indicators and the belonging text consequences. To show which of the indicators have been affected, the colour changes to green or red, and arrows are showing the increase or decrease, see figure 5.4.

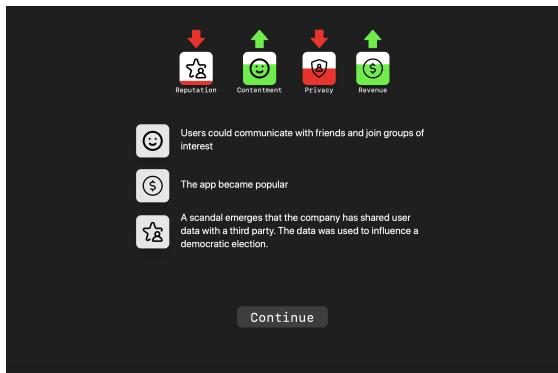


Figure 5.4: Final game: The consequence page with changing indicators and belonging consequences.



Figure 5.5: Final game: End page when losing the game.

5.1.4 End Page

Figure 5.5 is shown when the player loses the game where the text changes based on which indicator fell below zero. Winning the game shows the same page but with a different text. On the end page, an alternative to playing the game again is included.

5.1.5 Credits Page

The final page, see figure 5.6, is a credits page where the user is thanked for playing the game and encourages to fill out the questionnaire in 5.2. This page can be accessed after the player decides not to play again when the game ends.

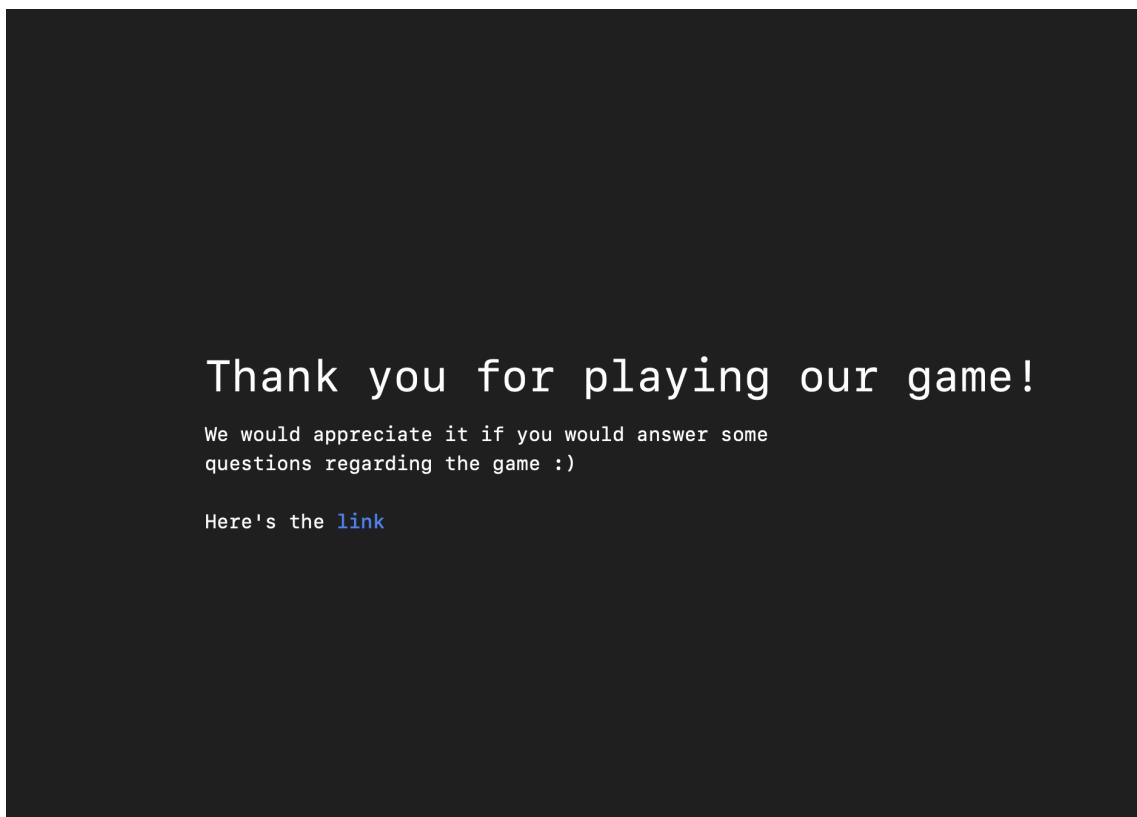


Figure 5.6: Final game: The end screen when the user decides to not play again.

5.1.6 Additional Features

In addition to the pages, there are some additional features that are implemented. One of them is a help-box explaining what the four different indicators mean, see figure 5.3. The help-box appears above the current page and greys out the background slightly. To reach the help-box, the player clicks on a button in the top-right corner of the game page. To close the box the user clicks on the "escape"-button on their keyboard or anywhere on the screen.

Another additional feature is the ability to use keyboard shortcuts in order to play the game. On the first page, "Enter" can be pressed to skip the rolling text explaining the game. On the main game page, the player can press "F" to flip the card and the player can also press "A" or "D" for Accept and Decline of the card. On the consequence page, the player can press "Enter" to continue to the next app. All keyboard shortcuts are shown with a tooltip under the button or card that it affects by hovering on it, see figure 5.7.

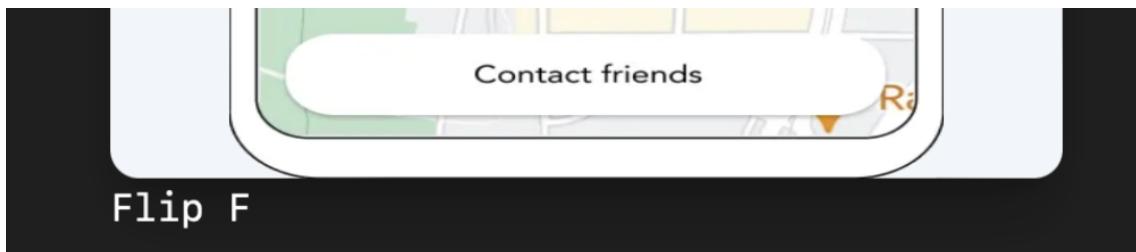


Figure 5.7: Tooltip of the keyboard shortcut for flipping the card on the game page.

5.2 Evaluation

When the game was finished it was evaluated by a group of master students, who were asked to play the game and then fill out a questionnaire.

5.2.1 Participants

The evaluation was set in a classroom with students of the course Human-centered Design and Human Factors (TDA487) at Chalmers University of Technology. The participants are a part of the target group and assumably have knowledge about usability and design.

5.2.2 Apparatus

The main equipment for the test was the finalised game and a questionnaire in Microsoft Forms. The requirements for test subjects, so they can participate, are a laptop or a tablet with a keyboard, internet access, a functioning browser, and a mouse or trackpad.

5.2.3 Procedure

The final evaluation was made to investigate if the project's purpose was reached, thus that the game was successful, by testing it on the target group of this project. The evaluation had the nature of a summative evaluation, explained in 3.2.3. A quantitative approach was applied due to the comprehensive account of user insights and performance being measured. A Likert scale was used for the quantitative questions, ranging from strongly disagree to strongly agree, as seen in figure 5.8, where all of the questions were mandatory [28].

	Strongly disagree	Disagree	OK	Agree	Strongly agree
The use of colors are excellent	<input type="radio"/>				
The use of theme/aesthetics is suitable	<input type="radio"/>				
I understand how to play the game	<input type="radio"/>				
This framework is suitable for encouraging discussion in a classroom about a topic (eg. ethics)	<input type="radio"/>				

Figure 5.8: Questions regarding the game with choices strongly disagree, disagree, OK, agree and strongly agree.

Additionally, five questions were asked, four non-mandatory and one mandatory to get detailed feedback on the project:

1. What comes to your mind when thinking about our website?
2. What do you like least about our website?
3. What do you like most about our website?
4. What did you think about the use of indicators?
5. After playing the game, how do you feel? (Mandatory)

The questions were asked using a questionnaire to easily get insight from a large number of test subjects. The test subjects were given a web address to access the game and play it, and lastly were asked to fill out an online questionnaire with their feedback and thoughts.

5.2.4 Evaluation Results

The questionnaire received 25 responses with mostly positive feedback, figure 5.9 shows the answers to the quantitative questions.

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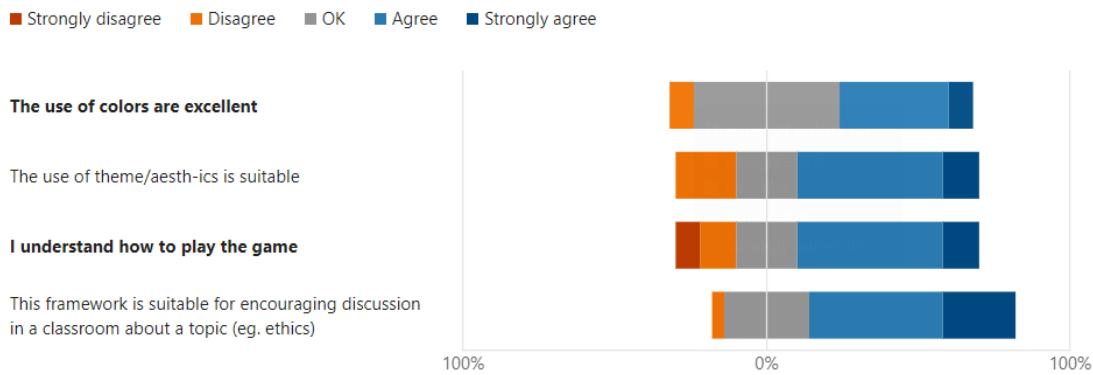


Figure 5.9: Summary from the first four questions of the questionnaire.

The rest of the questionnaire consisted of open-ended questions, to which the answers are found in Appendix C. The answers varied in quantity and details, for example quite clearly in questions two and three (*What do you like least/most about our website?*). A majority of the respondents thought the indicators in the game were good and some of the respondents had suggestions on how it could be improved, and some answered with overall input on the game. Most questions gave critical feedback which is useful for developers to improve the project.

6

Discussion

This chapter will present an explanation and analysis of the results and their contributing factors, as well as suggestions for future work and what could be improved.

6.1 Discussion of Test Results

Overall the test subjects seem to find the game enjoyable, understandable, and suitable for encouraging discussions about ethics in a classroom. As previously mentioned, the main goal of this project is to provide a game that can be used in an educational setting. 68% of the respondents answered that they agreed or strongly agreed that the game is suitable for encouraging discussion about for example ethics. This indicates that students are positive to learn about ethics in this kind of way. As mentioned in section 2.1, students enjoy games, which means that our findings correlate with previous research.

On question two (*What do you like least about our website?*) there is nothing that is consistent in the answers; various parts of the game are highlighted by different players. This indicates that there might be some various improvements to do. In question four (*What did you think about the use of indicators?*) some of the test subjects said they thought the indicators were confusing and provided potential improvements. Some of the test subjects found that some of the text descriptions of applications ended up outside of the card. The descriptions ended up outside because of the computer's screen resolution and should be taken care of if the game develops further in the future.

Most of the test subjects said they understood how to play the game. Some of them replied that they understood after playing one round of the game. Some people found the indicators hard to interpret and gave suggestions on how they could be more easily understood. This shows that we were fairly successful in creating a game that was understandable and easy to use, but since some suggestions for improvement were given, it could be relevant in the future to look further into the game's usability.

As stated in section 2.1 *Game-based learning*, games should be supplemented with other teaching methods. As stated throughout this report, the authors are not educated in ethics or pedagogy. Therefore it is hard for us to evaluate if, despite high interest from the test subjects, the game is actually enhancing students' learning. However, as stated in section 1.2.1 *Lack of teaching of ethics in computer science*

programs, methods to involve ethics in computer science are under development and experimentation. Therefore this project may still contribute and be useful in the education of ethics in computer science, especially if further developed by professionals in ethics and teachers to reach its full potential.

6.2 Choice of Method

When evaluating Prototype 1 and Prototype 2, one of the most important questions was to know if the prototypes reached the purpose of the project. To learn if the game could be suitable in an educational setting, we asked if the test subjects could learn about ethics in computer science in this way and if the game is suitable in a classroom. Later we learned, that the structure of the questions could be leading. Unfortunately, this could have affected the results of the evaluations. To solve this problem, the questions could have been more prepared and used a grading scale, such as in the final evaluation. In addition, the test subjects were people in our class or closely around us. This could create bias because they are not independent and constrain the result of the evaluation. A solution to avoid leading and poor questions and test the usability of the game better could be to use the System Usability Scale (SUS). This is a tested and reliable method for evaluating usability. The method could have improved our evaluations and therefore enhance the result.

Overall, we are pleased with the amount of insights we received from the three evaluations. According to Nielsen [34], the best results of usability testing come from small tests and no more than five test users. Additionally, Nielsen writes that testing with zero users will result in zero insights. The first evaluation had five participants, the second had six participants and the final evaluation had 25 participants. Therefore, we covered most of the usability issues during the evaluations and received valuable insights.

6.3 Challenges with Ethics

During the process of creating the game, we were faced with several ethical challenges, such as attempting to create and include unbiased content. While inevitable, we tried our best to mitigate these challenges as much as possible by researching other projects that had the purpose of teaching ethics and following the ACM guidelines that were mentioned in 2.3 to the best of our abilities. Critically Conscious Computing, described in 2.5, made us more aware of the potential ethical challenges that can appear when creating a game for encouraging ethics. Additionally, when creating the example applications, we had in mind that the ethics content should have been created by people working in the field of ethics, such as in Project ImpactCS, see 2.4.

That said, the content had to be created even if no professionals in ethics were present in this project. Therefore the applications were made to be as unbiased as possible by non-experts, which evidently was challenging. Using a design fiction

approach, as mentioned in 2.2, we were able to explore different fictional scenarios that required ethical thinking to make sound decisions. We had to decide what consequences would come from said decisions which, with our limited knowledge, could lead to consequences that could seem unfair as a result of our lack of ethical knowledge. However, by the lack of comments on the content in the final evaluation, see 5.2, the content could be considered unbiased and unnoticeable enough to not be criticised, since the test subjects had the opportunity to write anything they wanted. However, the lack of comments on the content could also be a result of our questions not touching that subject enough.

6.4 Similarities with Other Games and Projects

The game took great inspiration from the game Reigns, described in section 2.4.2. The similarities are clearly shown in the placement of the flashcard and the four indicators. The game was additionally influenced by the games Papers, Please, Moral Machine, and Detroit Become Human, described in sections 2.4.1, 2.4.3, and 2.4.4. Ethical conflicts and moral dilemmas are integrated into these games. To create a game for education and encourage to learn about ethics, it was helpful to study and research Papers, Please, Moral Machine and Detroit Become Human. The element in Moral Machine to save users' answers and display them is something that could be used in a future version of the game.

6.5 Possibility to add Custom Content

As previously mentioned, if the game is used by teachers it should be filled with their own content. Therefore the content must be easily modified. Since the contents of the applications are stored in an array, an app can easily be added or removed. Using an interface (*IApp*) to describe applications makes it easy to add detailed information in a way that is easily readable for humans while typesafe. The changes of content require programming skills but this should be no problem for computer science teachers or a team knowledgeable about ethics in technology.

6.6 Future Work

The game can be further developed with for example the defined features in the MoSCoW, described in section 4.3.1. Features from the category Should-have would be highest prioritised and features from Could-have would be second. These are only examples of further development we thought about, but there could be others too.

6.6.1 Better Applications in the Game

With more development, the game could be longer and have more well-developed example applications with the help of an expert on ethics. The example applications

would ideally be created by people who are well-educated within the field of ethics since we are not experts. The ones in the game at the moment were created to be able to test and present the project and the thought behind it since our focus was on the game.

6.6.2 Tutorial of the Game

A tutorial should be considered in a future release of the game. The tutorial would be helpful for explaining the game further and giving a background for the indicators. We began designing a tutorial in Figma but soon realised that we did not have enough time to implement it well enough.

6.6.3 Different Gameplay Modes

An evil mode should be considered in a future release of the game so that the user gets to experience both sides of ethics. Having two different game modes, a good and an evil mode, can give the game extended complexity and highlight the different ethical choices. The evil mode could for example focus on increasing the revenue indicator and the player should not care about the indicators' privacy and contentment. The evil mode would have the purpose of giving the player insights on how to actually make bad choices for the users whilst it might have good effects for the app store. The good mode would have the purpose of giving the player insights on how to satisfy both the needs of the app store and its users.

6.6.4 Modularity and Extensibility of the Code

The four stats (reputation, contentment, privacy, revenue) are hard coded at many places in the code. Removing or adding a stat would require changes in a lot of places, both in the frontend and backend. If possible, removing the hard coding of the stats would significantly improve the extensibility of the code.

If one wanted to make the information about applications more flexible, *IApp* could have certain properties optional or one could add more interfaces. A change of *IApp* or adding interfaces would require a change of the Game Page and depending on how great the changes are, the more the Game page would have to change as well.

The card displaying information about an application has two sides. This limits the amount of information that can be shown about an application. Both sides are currently filled with information so adding additional information would have to force the text or image to be smaller. Alternative solutions to avoid this could be to display the information across several pages instead of having a flippable card or to only show one side of the card and make the content scrollable.

6.6.5 Mobile Compatibility

Another great feature would be to make the game compatible with phones since most of the students do not always use their laptops during a lecture but have quick

access to their phones. Making the game compatible with phones is not that difficult and in this case, the time limit was the problem. We had the idea in the planning of the project but put it as a Could-have in the MoSCoW, meaning it could be a feature to implement.

6.6.6 Future Use

Lastly, the area of usage for the game is, as mentioned before, in a classroom. Teachers in ethics would create their own content, in other words, the applications and their consequences, and then bring it to a class of computer science students. The game would be used to encourage students to think about ethics in the field of computer science, in order to start ethical discussions in the classroom. An engaging and easily accessed game could encourage institutions to integrate ethics into their computer science curriculum.

Hopefully, this project will contribute to discussions about ethics by forcing the users to choose between two non-ideal scenarios. No choice in the game should have purely positive or negative consequences for any of the indicators. There could also be a possible future extension to collect data from users and display their answers in comparison to other players, as mentioned in 6.4.

6. Discussion

7

Conclusion

This project's purpose was to contribute to the education of ethics in computer science by creating a web-based game that can be used as a tool for educational purposes. The game puts the user in the role of an App Store employee. The user has to make decisions to reject or accept applications while taking different indicators into account, such as customer happiness and the company's revenue. Due to the thesis writers' limited knowledge of ethics, the focus was on the game rather than its content.

A game was created due to studies showing the learning potential of game-based learning and design fiction. Therefore, the game makes use of both game-based learning and design fiction. These methods turned out to be successful in the final evaluation. Testing of the game showed high motivation among students to use the game to create discussions about ethics in computer science. However, to improve the content of the game and evaluate its effects on learning, the input of teachers and professionals in ethics is required.

For future development, the game would be mobile-compatible for easier access by students, and creating a tutorial to give the user a better explanation of the game. The most important focus should, however, be a longer game with applications and consequences created by professionals in ethics, for more well-developed and scientifically based content.

7. Conclusion

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Bibliography

A

Responses from the First Evaluation

Testperson 1 (hubben, årskurs 3):

- Hade du kunnat tänka dig lära dig etik på det här sättet? Tror du det passar i ett klassrum?
De är bra att man får möjliga konsekvenser direkt än å tänka själv, men bra att tänka själv först, tänker lite så i första hand för att ratea den.
- Hur verkliga känns konsekvenserna? på skala 1-10.
6,5-7. Vissa va oj jaha de kan ju hända, medans vissa kunde man ifrågasätta moraliskt, tex de med familjen och spionera på sitt barn (har man rätt att göra så från början liksom).
- Är scenarierna trovärdiga?
Ah sure, kan finnas sånt.
- Övrigt
Utvecklarnas moral kommer speglas i appen, som användare behöver man ta hänsyn till de eller vara medveten om de, vore najs med en extra-övning där man sj kan sätta poängen, beroende på hur man väger konsekvenserna sj liksom.

Testperson 2 (hubben, årskurs 4):

- Hade du kunnat tänka dig lära dig etik på det här sättet? Tror du det passar i ett klassrum?
Kan tänka sig de som en grund, lite mycket gamified, man behöver tänka lite mer sj för att tänka efter lite mer.
- Hur verkliga känns konsekvenserna?
Alla är väl riktiga, sen poängen om de va rätt/fel meh. Bra att lite gråskaligt med både positivt/negativt
- Är scenarierna trovärdiga?
Yes.
- Övrigt
Lägga till mer förklaring, vad äre för spel, vad äre man ska reject/accept, svårt att förstå instinktivt (förstod med hjälp av frågot till steff).

Testperson 3 (IT3):

- Hade du kunnat tänka dig lära dig etik på det här sättet? Tror du det passar i ett klassrum?
Ja, känns roligare än att lyssna på en föreläsare. Lite mer verklighetstroget och bra att se konsekvenserna.

- Hur verkliga känns konsekvenserna?
Verkliga, saker som hade kunnat hända.
- Är scenarierna trovärdiga?
Ja absolut! dom skulle absolut kunna finnas i verkligheten.
- Övrigt
Testpersonen var överraskad att det fungerade att skriva Y på första sidan. "Nice". Testpersonen sa att det var lagom mycket information på App-sida 1. "Man vill inte ha för mycket text för då orkar man inte läsa". Testpersonen sa att det var bra och snyggt på Reject-sida 1. "Lätt att läsa", "Kanske lite oklart vad poängen betyder". "Antar att de är ett mått på hur bra/dåligt det är för människor". Testpersonen undrar om den första konsekvensen var bra på Approve-sida 2. Spekulerade om det var bra eller dåligt för en enskild individ. Testpersonen tyckte att det skulle ha kunnat skrivas om. "Snyggt och lätt att se, det är inte för mycket att titta på".
Snyggt bra jobbat. bra ide. inte för komplicerat. man förstår spelet. lätt att förstå var man ska trycka. inte plottrigt. info-knapp hade kanske varit bra. -+ var lite oklart, men lättare att förstå när gubbarna försvann där uppe. mer info på vad poängen betyder.

Testperson 4, Datavetenskap åk 3:

- Hade du kunnat tänka dig lära dig etik på det här sättet? Tror du det passar i ett klassrum?
Mkt roligare än läsa om etik, osäker om universitetsnivå. Har inte lärt sig om etik innan i kurser (endast i koppling till miljöfrågor) så vet inte riktigt vad som lärs ut men tror det skulle funka.
- Hur verkliga känns konsekvenserna?
Bra men "took a walk" känns meh
- Är scenarierna trovärdiga?
Ja men bättre advertising för mSpy
- Övrigt
Gillar det tekniska typsnittet som ser ut som Linux i början. Blå blubb på mSpy-appen?? Olaglig? Tycker mSpy borde ha mer säljande reklam/info t ex att den är till för att "skydda barn" ProfileNovel påminner om Facebook, roligt med "thinking of raining" Vad betyder gubbarna längst upp? Är det reviews? Kan man gå tillbaka? Man kanske skulle kunna ha mer info om varför data to third-parties är dåligt? Är oupptäckt infidelity och att sälja fake-makeup bra? Lite förvirrande när personen inte riktigt förstod vad gubbarna betyder
Gubbarna finns inte längst upp på första sidan
Mer tydligt vad personerna längst upp betyder!

Testperson 5, Datavetenskap åk 2:

- Hade du kunnat tänka dig lära dig etik på det här sättet? Tror du det passar i ett klassrum?
Jag tror det vore roligt, rimligt på universitetsnivå.
- Hur verkliga känns konsekvenserna?
profilenovel makes sense, känns som det borde "riplla" av sig/ gå rykten från de som använder mSpy: missing child + bullied bra, varför skulle man förlora användare för att man använt mSpy för att upptäcka otrohet? Borde vara

+20 missing child, liksom jättebra. Long-distance never found each other again känns konstigt att det göra att man förlorar användare, det har ju inte påverkat nåt. Small companies rimlig.

- Är scenarierna trovärdiga?

mSpy känns orimligt namn, reklam. profilenovel mkt trovärdig, liknar facebook. Gillar att mSpy är obvious ond och sen får man ändå att den kunde fått bra konsekvenser.

- Övrigt

Hittade inte trycka på y snabbt Är det här färdig design? Hade varit nice att kunna interagera med spelet när man tänker, t ex flera sidor att kolla i (t ex sida 1: beskrivning, sida 2: vad det kan göra), lite meh bara läsa och inget händer Varför ska jag approva mSpy? Känns väldigt svart-vitt, obvious dålig, tänker inte så mkt, snabbt reject. Tycker vi borde incorporatea konsekvenser i beskrivningen. Kanske separera mer på det positiva och negativa, t ex visa båda delarna för sig Tar lång tid att läsa beskrivningarna Väldigt lika konsekvenser för reject/approva mSpy, kanske variera lite mer? "Took a walk" rolig, lite kul, men varför gör det +2 gubbar? Fattar inte vad gubbarna betyder

Hur får man fler användare om man inte släpper en app? Känns ologiskt, idé att man kanske blir pressad att släppa appar om man bara får användare om man släpper saker.

Kanske ha en mätare för företagets rykte? Hur kan man få konsekvenser om man inte publicerar? Fler currencies som kräver att man approvar appar? T ex pengar? Kanske terms of service? Förklara mer varför man får en viss outcome! Typ varför får man +3 när man hittar missing child

A. Responses from the First Evaluation

B

Responses from the Second Evaluation

Frågor:

- **Hade du kunnat tänka dig lära dig etik på det här sättet? Tror du det passar i ett klassrum?**
 1. Ja.
 2. Ja.
 3. Ja.
 4. Ja.
 5. Nej
 6. Nej
- **Indikationen, "prickarna", lade du märke till dom?**
 1. Ja.
 2. Vad indikerar prickarna: det som påverkas om man declinar eller approvar? mSpy påverkas tre saker men står bara två saker.
 3. Nej.
 4. Ja (efter tutorial)
 5. Var inte helt säker, men gissade på att de var faktorer som var i fokus.
 6. Ja (efter tutorial)
- **Förstår du symbolerna?**
 1. Inte helt, förstod efter tutorial.
 2. Privacy och reputation känns inte så intuitiva.
 3. Ja.
 4. Contentment är lite oklar men det är mest för att jag inte vet vad contentment betyder, privacy tydlig. Reputation: också lite svårt begrepp att visa i ikon. Revenue tydlig.
 5. Förstod några av de men inte, smiley och stjärnan var lite svårare.
 6. Reputation och privacy var lite oklara. Men pengar och glädje förstår jag.
- **Hur verkliga känns konsekvenserna?**
 1. Känns vettigt, men känns aningen subjektivt.
 2. Blandat svar (se Emmies test för mer utförligt)
 3. Känns verkliga.
 4. Rätt rimliga.
 5. Det kändes ganska logiskt.
 6. Känns så verkliga som man kunde få dem

- **Övrigt (Sammanfattning av vad som togs upp på övrigt, försökte ta saker som inte sagts innan)**
 - Skugga hela appen i första tutorial-bilden, blev för mycket.
 - Gillar estetiken på förstasidan och känslan i spelet att man är en admin, känns roligt som programmerare. Gillar symboler och färger men clashar lite med resten av estetiken.
 - Vill gärna kunna hovra över symbolerna för att kunna se vad de heter om man glömmer
 - "tutorial kanske lite för lång, känns som man bara skulle klicka igenom den"
 - "Bra för utvecklare att köra så att man tänker på etik"
 - Tycker appen passar bra som en webbapplikation. Gillar designen.
 - Gillar inte att korten vänder sig när man drar muspekaren lite smått över dem, utan hade föredragit att man behövde dra över hela kortet eller klicka på det, tyckte inte riktigt att man hade någon kontroll.
 - Hade velat att det fanns ett sätt att urskilja accept och decline knappen med bortsett från texten, kanske genom olika färger eller ikoner.

C

Responses from the Final Evaluation

ID	The use of colors are excellent	The use of theme/aesthetics is suitable	I understand how to play the game	This framework is suitable for encouraging discussion in a classroom about a topic (eg. ethics)
1	Strongly agree	Agree	OK	Strongly agree
2	Agree	Agree	Disagree	Agree
3	Agree	Agree	Strongly agree	Agree
4	Disagree	OK	Disagree	OK
5	Disagree	Disagree	OK	OK
6	OK	Agree	Agree	Agree
7	Agree	Disagree	Strongly disagree	OK
8	Agree	Agree	OK	Agree
9	Strongly agree	OK	Strongly agree	Strongly agree
10	OK	OK	Agree	OK
11	OK	Agree	Agree	OK
12	OK	Agree	Agree	Strongly agree
13	Agree	Agree	Agree	Strongly agree
14	OK	Strongly agree	Agree	Agree
15	Agree	Disagree	Agree	Agree
16	OK	Agree	OK	Agree
17	OK	OK	Disagree	Agree
18	OK	Disagree	Agree	OK
19	Agree	Agree	Strongly agree	Disagree
20	OK	Strongly agree	Agree	OK
21	OK	Disagree	Strongly disagree	Agree
22	OK	Agree	Agree	Strongly agree
23	Agree	Strongly agree	OK	Agree
24	OK	OK	Agree	Agree
25	Agree	Agree	Agree	Strongly agree
ID What comes to your mind when thinking about our website?				
1	Opens up for good discussions, want to really think through before deciding to not lose			
2	It is well-designed, I especially liked the fonts. :)			
3	It was a nice website, moderately interesting			
4	Ethics issues and problems			
5	Interesting			
6	the first sight seems like it's a hacker website since it record my computers' type.			
7	I do not understand its purpose			
8	It was a little bit unclear how close to "game over" you are. I got it at the end but it had me confused for a moment.			
9	Love the text. How it is displayed character by character			
10	It's good			
11	The terminal aesthetic feel suitable for the target audience. It becomes apparent that it's hard to account for all factors and predict scandals etc.			
12	fun game when it comes to seeing the consequences of your actions. However a bit more work could be done on the design part. It looks a bit flat and i dont really feel like it has a clear design direction. i liked the type y/n part			
13	I got confused the first time about the four icons at the top, but after losing one time I fully understood and completed the game on the next try.			
14	I really like the straightforward UI. I wish you could have used color in a more deliberate way to communicate wether the player wins or loses, as of now there is no visual difference except for the text.			
15	It started with a good introduction and theme which target mainly to the IT student. The instruction is also easy to understand; the user is able to understand quickly.			
16	idk			
17	The game reflect well the fact that there rarely are any clear dividing lines of good or bad decisions in ethics, most questions reside in a gray area.			
18	It wasn't immediately clear exactly what the game would entail. A very interesting topic on the other hand.			
19	When the first card showed up I did not understand what I was trying to do. However after the first screen with the indicators I quickly started to understand what to do.			
20	The game was happening too fast, I lost on round 2 and didn't have time to change my approach before loosing and playing again. If the game was longer I would have had time to course-correct my play style and win first time.			
21	I had a hard time understanding how the game worked and even though people explained it I sometimes did not agree with the software and I died. Other than that I think it is good to think about the ethics behind apps.			
22				
23	Really funny to see the game			
24	I gives me an ARG vibe in the beginning, but then it turns into more of a "Tinder" vibes where you swipe left or right on the apps. I would recommend to either focus on the ARG vibes (Terminal writing etc) or the Tinder vibes. I would recommend to check out the game "Reigns" for inspiration.			
25	Old-school game with decision mechanics that may produce unexpected consequences, good for starting discussions.			
ID What do you like least about our website?				
1	The texts did not fit my window :(
2	It is not clear what the goal of the game is			
3	Nothing really stood out, perhaps the colors could have been stronger and more interesting			
4	Many text			
5	The UI design could be better			
6	no			
7	understandability			

- 8 I didn't like that I had to read through the whole thing in the beginning again when i wanted to play again.
- 9 It did not adjust to my screen
- 10 presentation of subject apps screenshots etc
- 11 Mostly technical stuff, like the aspect ratio of the images and not seeing the text even though I zoomed out.
- 12 the design. maybe too much information on the back of cards as well. I felt like i missed something everytime. I dont want to spend too much time reading when playing.
- 13 could have had better explanations while in game. Like small question marks next to certain things at least for the first game you evaluate so that the user really understands.
- 14 Perhaps the difficulty, It would be nice to have some more time to calibrate. I think this is just a matter of increasing the amount of apps to evaluate, and decrease the impact on your score each app has. This gives the player more time to adjust.
- 15 the image of the application is unclear and sometimes hard to understand. Using look alike real mockup application could be helpful
- 16 The bugged text making some cards hard to read.
- 17 I feel like the use of space could be better. Having the description of the app visible alongside the screenshot should be possible.
- 18 It felt a bit unpolished.
- 19 It was quite hard to determine when a factor would increase or decrease, but I assume that was the point.
- 20 Unclear rules on first play through. It was unclear what the four criteria were before playing the game.
- 21 The game. I thought it was hard to learn something while playing it due to the fact that I died all the time. I only won once of many.
- 22 The example's interfaces
- 23 How it works
- 24 It was unclear how to win or lose the game, which had to be figured out by trial and error.
- 25 The reasons seem very arbitrary and random so they might not be relevant to any reasoning that you make about an app, this might just be with your demo cards :)

ID What do you like most about our website?

- 1 The names for the applications were funny! Good way to think about my choices before making them
- 2 I like the starting-page
- 3 The look of the introduction text
- 4 Explain with examples
- 5 It's a interesting way to evaluate
- 6 When I log in I see some words appear orderly. It's good and give me a premise
- 7 design
- 8 I think it makes you consider new aspects and imagine what consequences any app could potentially have.
- 9 How you are greeted when entering the website
- 10 concept
- 11 It's very quick and light making it fast to get into and start the discussion.
- 12 the idea and thought evoking process
- 13 Educational and fun
- 14 It took a few tries before I understood why I would lose, which was probably the point. I like the simplicity of the game, while at the same time it manages to raise awareness of ethics. Its nice.
- 15 the reason that the application gives is helpful and help the student to learn about ethics
- 16 clean aesthetics and visuals
- 17 Pretty good looking. Interesting take on the subject.
- 18 Interesting and relevant topic.
- 19 It had a clear feedback to the effect of my choices.
- 20 The visual theme is very appropriate.
- 21 The ethics behind it.
- 22 The concept is good and also the flip to the description
- 23 The symbol
- 24 How simple it was. It was also nice that it was randomised, so that it was a unique experience each time. I can see how this game could potentially be expanded upon in the future.
- 25 The style that is similar to the terminal and how it caters to the computer scientists (nerds).

ID What did you think about the use of indicators?

- 1 They were good, but did not think so much about it
- 2 Its cute
- 3 I did not really notice them
- 4 Not quite relevant
- 5 Reasonable
- 6 good
- 7 indicators are useful when showing expressing ideas
- 8 I think it was quite clear that green was good and red was bad but the blue (which I assume was no change) had me a bit confused. Maybe a +/- 0 or something
- 9 Good
- 10 good
- 11 They worked well even though when you reduce factors it always simplifies the problem. I would have wished to have some explanation of them in the instructions before the game instead of just mentioning them.
- 12 Worked ok. Hard to tell sometimes what they were
- 13 Okay, may be better if it had better and longer explanations for the consequences of your choices directly after you have made them.
- 14 I like it. It is also really good that there is an explanation of each category. The usage of color is also really nice.
- 15 Appropriate but could be better with the progress bar that could represent the remain level out of 100
- The dot indicators showing which factors are gonna be affected are very confusing, you should make it consistent with big circles being positives and small being negatives. This would however defeat the purpose of reading the cards so maybe just remove big and small and just have standard size circles for both positive and negatives to force the player to actually read the card.
- 17 Not sure what's meant by indicators. If it is the ethical dimensions I think it could be argued that they are arbitrary, and the effect of a decision is conjecture.
- 18 Assuming that indicators refer to hints of interaction I would say they are used as would be expected.

19	The use of indicators made the action of your choices very clear.
20	Didn't see them before double checking to answer this question.
21	I had a hard time seeing them and understanding it.
22	I think during the game, it would be better to add a warning that to keep all factors over 0
23	
24	They were good, took a while before I figured them out but it was possible to build a strategy around them when accepting or rejecting apps
25	They look good but at first they seem clickable.
ID	After playing the game, how do you feel?
1	Well! I won the game, it was funny
2	i feel good
3	It was a nice low impact experience
4	Kind of confused about the result
5	Very interesting! Could be developed better in terms of UI design and instructions about the game.
6	very good to be empowered a right to decide whether to purchase the app.
7	neutral
8	I feel like it was over way to quick. I wish you would get a bit more time and cards to go through before you lost the game.
9	Good
10	good concept
11	I feel good. I got a bit confused but overall it was a pleasant experience.
12	I enjoyed it! good work
13	Good, because I won.
14	It was fun and engaging. I wish it was longer!
15	Great! could be developed further. By applying storytelling to the application would help the user feel more immersive. Good luck :)
16	The concept of the game seems good but as stated below some of the indicators ruins the game since they have no consistency.
17	Feel good! Interesting concept and important subject.
18	I don't really feel anything in particular. It's not like it was this overwhelming eye-opening experience or anything but it presented the issue at hand in a relatable way.
19	I feel like I just played an incomplete game. It was too short.
20	Interesting game with potential to be played in a school environment, needs polish.
21	After playing the game I feel down by the fact that I died all the time. Apparently, my ethical intuition is off. Otherwise, the aesthetics of the app/game was very minimal but because ethics is the important part it was still okay.
22	Interesting and meaningful concept.
23	Really good and interesting
24	I feel fine. What about you???? ;)
25	xxx Basically the same :)