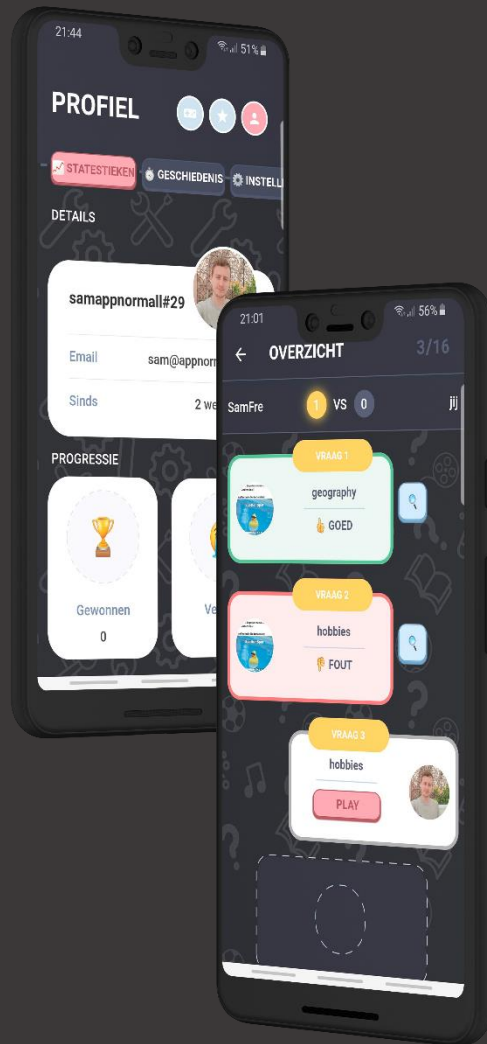


# Creating a **functional** *prototype*



How to develop a prototype of an online multiplayer trivia app that is ready for further development and attracts users from 20 to 40 years in the mobile app market?



# Graduation report

Saxion University of applied sciences

**Creative Media and Game Technologies**

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# Preface

What you are reading is my graduation thesis with as research question: *"How to develop a prototype of an online multiplayer trivia app that is ready for further development and attracts users from 20 to 40 years old in the mobile game market?"*. This thesis is created for the graduation process of Creative Media and Game Technology at Saxion University of Applied Sciences in Enschede. The period I worked on this thesis was from February 2020 till July 2020.

The research and prototype were made as an assignment for Appnormal. Together with Coen Heck, we created a graduation assignment for this thesis. A prototype of an online multiplayer quiz game that has the features of a modern mobile game is the main subject for this assignment.

During the research, I looked at what features a modern mobile game would need to be able to become successful. These features are implemented in the design and prototype. The research results are used to answer the main question and to create a working prototype. This prototype has been through multiple iterations to ensure the quality and the usability for the company.

With this introduction, I want to thank everybody that helped me during my graduation period.

At first, I want to thank the team of Appnormal for the fun and educative experience, even though the Covid-19 virus sometimes made it a bit more challenging to work together. Special thanks to Corina Bodnariuc for the excellent guidance and helping hand for my product.

Second I want to thank all my Saxion teachers that gave their knowledge that made this all possible. Especially my graduation teacher Kasper Kamperman, for the guidance during this graduation process.

Finally, I want to thank my parents for their support and motivation to complete this graduation.

- Sam Freriks, 15 June 2020

# Abstract

Appnormal is a mobile application development company that had the wish to create an online multiplayer quiz game. This quiz game should have the right features to be interesting and appealing to the user.

The purpose of this research is to find out what certain features and design choices are needed to create an interesting and appealing mobile game. Therefore the following main research question has been created: *"How to develop a prototype of an online multiplayer trivia app that is ready for further development and attracts users from 20 to 40 years old in the mobile game market?"*.

To answer this research question literature and qualitative research has been conducted through the means of interviews, prototypes and user testing.

In consultation with the company, a concept for the game was created. The concept consists of an online multiplayer quiz app.

A high fidelity prototype of the UI was created and tested multiple times with the users. After iterations on the UI design, a more complex working prototype has been created.

The working prototype also had various iterations in combination with code reviews, to ensure quality and usability for the company. In the end, usability tests of the prototype were used to find potential bugs and to see how the prototype behaves in the field.

Based on the findings of the user tests and the research, it is advised for the company to wait with the deployment until all features that were created in the concept are fully developed.

As for advice for the follow-up research, it is recommended to search specifically on marketing campaigns. The results of this follow-up research can be used to create an effective marketing campaign before releasing the app to the public.

To answer the main question. For the design, it is essential to make use of available heuristic evaluations like the Nielsen heuristic. This will provide make sure the interface will have the right properties.

For the prototype, it is essential to make use of standard code conventions and good version control. This will give the developers, that need to continue working on the project, enough support that makes it easier to continue working on it.

The product should make use of enough incentives to transform the users into returning users.

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# Glossary

<b>Digital prototype</b>	A prototype made with a digital design program, it is clickable and qua design comparable with the real product.
<b>Push notification</b>	A push notification is an automated message sent to the user which he/she will receive on their app.
<b>iOS</b>	iOS is the operating system used for mobile devices manufactured by Apple Inc.
<b>Android</b>	Android is an open-source operating system used for smartphones and tablet computers created by Google incl.
<b>Flutter</b>	Flutter is a free and open-source mobile UI framework created by Google and released in May 2017. It allows you to develop mobile applications which can run on multiple platforms with only one codebase.
<b>Dart</b>	Dart is a client optimised programming language for apps on multiple platforms. Google developed it for the use of mobile, desktop, server and web applications.
<b>PHP</b>	PHP is a popular general-purpose scripting language that is especially suited for web development.
<b>MVC</b>	MVC stands for 'model view controller'. It is an application design model comprised of three interconnected parts. They include the model (data), the view (user interface) and the controller (processes that handle input).
<b>Laravel</b>	Laravel is a free and open-source PHP framework. The framework follows the MVC architectural pattern. This framework makes it easier for the developer to create a back-end solution.
<b>Front-end</b>	The front-end of an application or a website has to do with everything the user sees
<b>Back-end</b>	The back-end of an application or website is also called the "server-side": The server-side controls how the website/application works, updates and changes.
<b>CMD-Methods</b>	CMD-methods are a set of research methods that are proven to be successful in the media/entertainment industry.
<b>ICT-Methods</b>	ICT-methods the ICT equivalent of the CMD methods but more focuses on ICT projects and questions.
<b>Git</b>	Git is a free and open-source version control system, which helps with versions control, collaboration and more.

1 Introduction

2 Problem indication



# 1 Introduction

## 1.1 Subject – Mobile games

Since the introduction of mobile apps, the popularity has been increasing. In 2018 apps downloads increased by 15.3% compared to 2017. Mobile games are the most downloaded category and around 15% more downloaded than the second place, which is business (Blair, 2019). In 2018, 77% of all app market revenue came from mobile games (Goor Iqbal, 2019). In this report, the conducted research is summarised. The following topics are researched: Mobile game features, UI design, creating a working prototype and app monetisation.

## 1.2 Graduation assignment

The graduation assignment consists of researching what makes mobile games addicting and fun to play and also creating a working prototype that implements the findings of the research. The prototype should consist of a working online multiplayer trivia game.

### **Starting point**

Mobile app development, UI and UX design, game development

### **General objectives**

Concepting, designing and developing a prototype of a mobile game that implements the needed features to become a successful app.

### **Description of graduation assignment**

The research will be focussed on what it takes to create a successful mobile game and how it can be used to generate a source of income.

Besides researching these topics, a prototype of a mobile game will be created. This prototype will be user-tested and will implement the findings of the research. The prototype will be created in a way that it is easy for the company to continue working on it.

## 1.3 About the client

The main client of the graduation assignment is Coen Heck, the CEO of Appnormal.

Appnormal was founded in 2010, with application development, in combination with technical software solutions, as the main focus of the company. Appnormal is established at Roomweg 79 Enschede. During the development of the company, they have added more services to provide a more all-round production. These include the creation of concepts, UI/UX designing and marketing of the products. The goal of these services is to make the end product more user-oriented and to strengthen the company's position.

Appnormal has a young and professional team. Every team member has their expertise in a certain part of development. The team consists of iOS, Android, back-end developers and a designer. The diversity in the group gives them the ability to create the most diverse and complex applications.

My supervisor during the project is Corina Bodnariuc, one of the app developers at the company. Her background is in Android and Flutter development. I will be working alone on the project but occasionally with the help of the company. The communication with the company will be through meetings at the company because I have a workspace in the company.

## 1.4 Why Appnormal

During my studies, I specialised in many different disciplines, as most of them were interesting. In group projects, my main task has always been that of the programmer, but in my spare time, I was always busy with 3D modelling/animation.

During my first internship, I noticed that programming, in combination with UI/ UX design, was my favourite activity and 3D modelling was not something I wanted to pursue. Considering this, I decided that during my graduation, I tried to combine programming with UI/ UX design.

The graduation opportunity that was open at Appnormal immediately got my interest because it combined all the elements that I wanted to do.

## 2 Problem Indication

### 2.1 Reason for the assignment

In 2012, Appnormal created the mobile game Rummified. This app became a big success and still has a large userbase to this day. Appnormal would like to create another big hit, but the competition in the app stores has increased dramatically. Appnormal does not precisely know what features a successful mobile game would need. For this reason, Appnormal would like to have a research on mobile games and on what it takes to make them successful. Together with this research, they would like a working prototype that keeps the findings of the research in mind.

As for the mobile game, which is the main product of the assignment, the company sees it as an exciting opportunity which they eventually want to market and use as a showcase to their portfolio.

Another reason for this assignment is because of my interest in mobile game/app development.

### 2.2 Question of the client

Appnormal asks for a finished concept together with a working prototype of a mobile game that is ready for further development. Besides the prototype, the company would like recommendations which indicate what features could be added to the prototype to make it more complete.

### 2.3 Stakeholders

Appnormal is one of the stakeholders of the assignment. After the graduation period, the company wants to take over the product for further development.

The second stakeholder is the userbase that uses the app. The app needs to be intriguing enough to retain users.

The third stakeholder is Saxion. Saxion requires documentation of the process. The requirement to pass graduation is a sufficient grade on all the twelve CMGT competencies. Therefore the project must include all the twelve CMGT competencies to a certain degree.

### 2.4 Limiting factors

The limiting factors of this assignment are time and the fact that it will be my first time working with mobile and back-end development.

To create a fully working prototype with a working front-end plus back-end is overambitious, for these reasons, some features may not be fully functioning at the end of the period, but the basic game should be playable. During planning, it should be taken into account that I do not have much experience with application development.

Another limiting factor is the fact that the code needs to be readable for other people as well. This will increase production time as the company will do code-reviews and code needs to be adjusted to their standards.

Because of the Covid-19 virus, it may be harder/take longer to get feedback from the company. Without feedback, it can take longer for me to create a working prototype and will decrease the functionality/documentation of the end product.

## 2.5 What will the client do with the result

At the end of the graduation period, Appnormal wants to take over the product for further development and deployment. When the product is fully developed, the product will meet all the requirements and will meet the standards of the company. The app will be marketed and launched in the Google Play Store and Apple App Store. The product will be used as a mobile game for international distribution. Besides deploying the app as a mobile game, the company sees the potential to use the app inside the educational field.

3 Theoretical framework

4 Problem definition

## 3 Theoretical framework



Figure 1 Methods used in this chapter

This chapter consists of the summarization of the conducted research to get a better insight on the subject. During the development of the product, this research will be used as a primary source of knowledge.

To understand the subjects and to create a definitive problem definition, different types of research have been conducted. These vary from **literature studies** to the app markets and what features popular mobile games have in common, to **expert** interviews on their take on needed game features. Methods from the **CMD-methods pack** have been used to ensure the quality of the research. The methods used in this chapter are represented in Figure 1.

### 3.1 Technologies

#### 3.1.1 Different technologies

Apps can be built natively or with a framework. Frameworks typically have the advantage that apps only have to be developed once and are still able to run on Android and iOS.

Generally speaking, there are two different products to an app: the front-end and the back-end. The front-end is shown to the user and it is used for the interaction. The back-end is what is used to set-up the server and database.

Flutter and Laravel are both frameworks for the front-end and back-end, respectively. A more detailed comparison and explanation of these frameworks and terminology can be found in appendix 2.

#### 3.1.2 Choice of software

A meeting with the developers of the company has been conducted to determine the choice of software. The pros and cons of different frameworks and solutions have been discussed to find the optimal solution. Details of this meeting can be read in appendix 3.

#### Front-end

Flutter has been concluded to be the best solution for the front-end. This is because of the

existing experience that the company has with this framework. This framework will make it possible for the company to provide help when needed and it has the ability to deploy on both Android and iOS.

### **Back-end**

The best option for the back-end is Laravel. Appnormal has a lot of experience with this Framework which will make the prototype reusable and makes it easier for Appnormal to help the student when needed.

The full explanation of why these frameworks are chosen can be found in appendix 4.

## **3.2 Users**

### **3.2.1 Who are the players of quiz/trivia games?**

---

Multiple popular trivia games and a tv-show have been researched to get insight into the target group that play trivia.

The first one is a tv-show called 50/50. From this tv-show Appnormal got the first idea of making a trivia game. This tv-show is chosen because the concept of the game will look like this tv-show, only converted into a mobile game. The other two apps are selected because according to (Yasmin Abbas, 2018), writer at XGN, a games news website, HQ trivia and Trivia crack are the top two best trivia games. The different audiences are compared to see if there is a connected target group. The full research can be read in appendix 5.

### **Research conclusion**

It was concluded that the target audience will be from the age 20 till 40. This target audience is familiar with the use of apps, which means that the app does not have to be simplified more than necessary. If the target group had been older, different design decisions should have been made, for example, in the size of the buttons. For a younger audience, for example, the app should have been made more childlike.

## **3.3 Features**

### **3.3.1 Looking at examples**

---

To get insight into important game features, I researched two popular mobile games.

Pokémon Go is chosen because it broke several records in popularity (Swatman, 2016). Rummified is chosen because it is an App that was created by Appnormal, this makes it possible to get knowledge about this product that is not available to the public. The apps are compared to see if any similarities could have provided for the success of the apps. The full research can be read in appendix 6.

### **Conclusion**

Both these games are free to play and available on both Android and iOS. This combination makes it easy for all users to start playing the game and is part of the success of both the apps.

### 3.3.2 Expert interview features

---

An expert interview with one of the developers of the company and former game engineer (Roy van der Veen) was conducted. In this interview, game features and the Fifty Fifty concept from the company have been discussed (appendix 9).

#### **Conclusion**

The interview concludes that the most important feature of the app is the game functionality itself; this needs to be working correctly before adding any other different elements. Additional features that do not improve the game are nice to have but not necessarily required

Besides the game itself, the following features are essential for a mobile game to be successful :

- Solid log-in method
- A profile screen for the player
- Users should be able to search for a game
- Users should be able to play the game
- Users should be able to play against another user

The following features are nice to have but are not necessarily required to make a mobile game:

- Statistics page
- Leader board
- In-game purchases
- Player bonuses
- Skins

### 3.3.3 Literature research mobile features

---

To find out what features are necessary to create a fun experience, a book and multiple blogs have been researched. The full research can be read in appendix 7. The conclusion of this research is as follows.

From the research, we can conclude that the following features are important to create a fun and engaging experience.

- User interface
  - the user interface should appeal to the user and make it feel like a game.
- Social status
  - the players need to be able to show their level or skill.
- Compatibility
  - The game needs to be playable on the device of the players choice.
- Simplicity
  - The app needs to be self-explanatory and should not require any hard tutorials.
- Feedback
  - The app should give feedback to the user to show it is leading or processing.
- Goals and rewards.



- The users should be rewarded for completing goals.

### 3.3.4 Conclusion features

---

From the different researches, the following conclusions can be made:

The app needs to be free to play and available on both iOS and Android. This will be realized by making use of Flutter as a framework.

The game functionality should be the top priority of the prototype, as this is the most important aspect. Therefore this will be the first focus of the prototype, and other additional features can be implemented if there is time left.

During the design process, the results of chapter 3.3.3 and appendix 7 should be taken into account. These features and insights will make the app interesting and fun for users.

## 4 Problem definition

The problem definition is based on the preliminary problem definition (Appendix 1) and the research conducted on various topics regarding the issue in chapter 3.

The main difference between the preliminary problem definition and definitive problem definition is that the second one is more specific target group together with the choice of software and features.

The company wants to release an online multiplayer trivia game but does not have enough knowledge about mobile games to create a successful game in the current market.

The concept of the mobile game is a turn-based online multiplayer game. The main idea comes from the tv-show 50/50, but with the right features to transform it into a mobile game. The company would like a functional prototype that takes the results of the research regarding app features and engagement in mind.

For the theory in chapter 3, we can conclude that the framework that will be used to create the prototype will be Flutter. The solution that will be used for the back-end is Laravel.

The target audience is created with the research of chapter 3 in mind. The target audience for the mobile game will be people from **20** till **40**.

### 4.1 Main-question

The main question of this assignment is as follows:

**“How to develop a prototype of an online multiplayer trivia app that is ready for further development and attracts users from 20 to 40 years old in the mobile game market?”**

### 4.2 Sub-questions

The following sub-questions have been made to help answer the main question.

- *How does an app become successful and profitable?*
- *How to make an app easy and appealing to use?*
- *How to develop a functional prototype that is valuable for Appnormal?*

### 4.3 Approach

This research will follow the design thinking method. To ensure quality when possible, the primary source of information will be scientific papers, interviews with professionals and first-hand user experiences. At every sub-question will be explained what methods will be used to answer the question.

### 4.4 Scope

The assignment will be performed by one student working on the project, with on occasion, help from the company. Given the problem statement, research question and methodology, a scope can be deducted. The goal is to have a functioning prototype that has a working

back-end. The UI of the prototype should have been tested multiple times during development. Additional features that are not functioning should have proper documentation so the company can develop them themselves.

After the research and interview, as described in chapter 3, a list of requirements was created. The requirements of the product are divided according to the Moscow method.

### **Must-haves**

Requirements labelled as “*must-have*” are critical to the current delivery timebox for it to be a success. The product has failed if one of the “*must-have*” requirements is not working.

- Onboarding
- A tested UI
- Login screen
- Home screen
- Ability to play a game with a random player
- Working game functionality

### **Should have**

requirements labelled as *Should have* are important but not necessary for delivery in the current delivery timebox.

- Ability to create a game with a known player
- Players profile screen
- The ability for the player to personalise their profile

### **Could have**

Requirements labelled as *Could have* are desirable but not necessary. These will be included if time and resources permit.

- A player’s statistics page
- Avatar for the player
- The ability to send friend requests

### **Won’t have**

Requirements labelled as *Won’t have*, have been agreed by stakeholders as the least-critical, lowest-payback items, or not appropriate at that time.

- in-game currency
- working advertising
- multi-language support
- in-game purchases

## 5 Concepting / Monetization

Sub-question 1

## 6 Designing

Sub-question 2

## 7 Prototyping

Sub-question 3

# Concepting / Monetization

## 5 How does an app become successful and profitable?

### 5.1 Goal

The goal of this sub-question is to find the best approach of monetization and what features can be added to retain the users.

### 5.2 Method

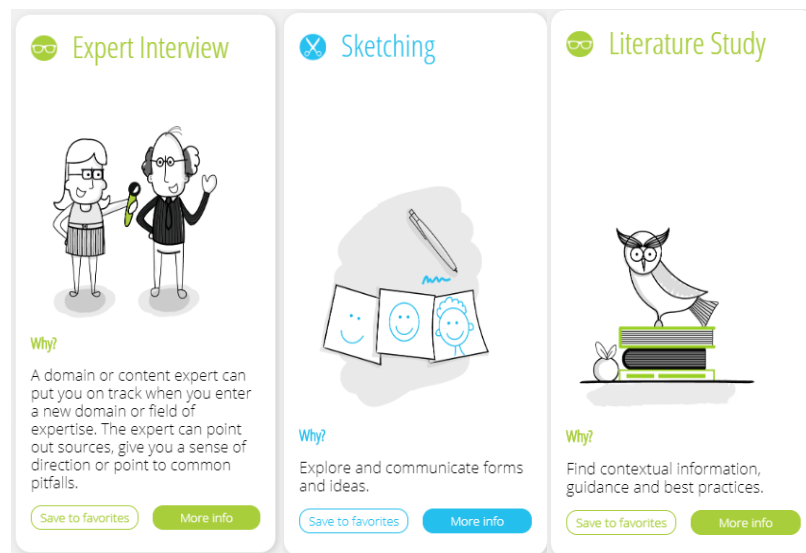


Figure 2 Methods used in this chapter

The used methods are represented in Figure 2. **Monetisation** and **engagement** are studied through **literature research**. To ensure the quality of the results, when possible and when relevant, only the most current and reliable sources have been used. An **expert** has been **interviewed** to gather personal experience on game monetisation. The results will provide information on what the app needs to have to become successful. **Sketching** has been used to define the concept and flow of the app.

### 5.3 Results theory

#### 5.3.1 Monetisation

##### 5.3.1.1 Apps and commercial success (literature study)

There are three major processes to optimise to achieve commercial success. **First**, the app needs to get as many users as possible as fast as possible. **Secondly**, users need to keep coming back to the app. Once the players have installed the app, the app needs to engage the players for them to stay. The **last step** is to monetise the app. It is essential to keep

monitoring the game to make sure the monetising does not push away the users. (Dheandhanoo, Theppaitoon, & Setthawong, 2017)

### 5.3.1.2 Free-to-play vs Premium applications (Literature study)

There are two different kinds of monetisation methods, premium applications and Free-to-play games, also called F2P. F2P apps are provided for free, while the premium applications cost money. When an application is launched for free, the distribution of the game can go wide really fast. (Dheandhanoo et al., 2017) The free to play concept is increasingly getting popular, and looking at the trend it is not going to stop in the coming years. (Paavilainen, Hamari, Stenros, & Kinnunen, 2013) (Alha, Kinnunen, Koskinen, & Paavilainen, 2018) As an example, Team Fortress 2 was released in 2007 as a paid game, in 2011 it was re-launched as a free-to-play game; this resulted in a twelvefold increase in revenue. (Patrick Miller, 2012)

Facebook games became very popular because of the free-to-play aspect in combination with the social aspect. (Mäyrä, 2011)

Most downloaded apps are free. 98% of all the revenue from apps worldwide come from free apps (Blair, 2019), this is displayed in figure 3. Some gamers are fearing that “real” games will slowly disappear because of the growing trend in F2P games. (Alha, Koskinen, Paavilainen, Hamari, & Kinnunen, 2014)

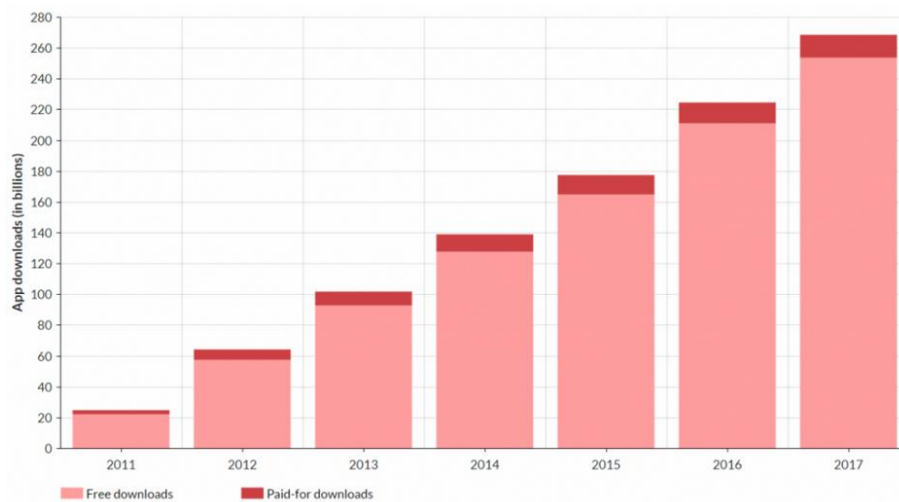


Figure 3 App download world wide (Blair, 2019)

### 5.3.1.3 Monetising experience (expert interview)

Roy van der Veen (former game developer and back-end developer) has been interviewed to talk about his experience with mobile games and the monetization process. The interview can be read in Appendix 9. The three most important remarks from this interview are as follows.

**At first**, it is essential to get enough publicity. To get publicity, one can make use of existing connections or to go to already popular websites/blogs and ask for a review of the game.

**As second**, is it essential to make use of as many possible ways to monetise the game. Do not limit the app to a particular style of monetising but always use as many monetization options as possible.

**As third** is it essential to give the users something in return, for instance, provide the user some extra experience points or in-game currency when they complete a video advertisement.

#### **5.3.1.4 In-app purchases**

In-game purchases are generally divided into four different categories. (Kananen, 2014)

- Content
  - These purchases consist of additional characters, levels or game-modes.
- Convenience
  - These purchases will help the player skip to a certain level that otherwise would have taken the player time and dedication.
- Competitive advantage
  - These purchases will give the player an advantage against the game or other players.
- Customization
  - These purchases consist of skins, expressions, adoring and personalisation. The customizations are also used as a status symbol inside the game community.

Generally, players see the use of in-app purchases as a good thing. If the money spent would turn the game into a better experience, most users do not see a problem with it. When an in-game purchase gives an unfair advantage, it will divide the game into paying players versus non paying players. (Alha et al., 2018)

At the moment, Fortnite is the most popular F2P game that is available. The total revenue of 2018 is estimated at 2.4 billion dollars (Mansoor Iqbal, 2020) In the game players can buy V-Bucks, the currency of the game. In-game purchases are nothing new, but what Fortnite does differently is the fact that all the purchases do not give the players any advantages above other players. This is seen as the main reasons why the F2P model works so well in this game (Cai, Yvette Wohn, & Freeman, 2019).

#### **5.3.2 Engagement and retention**

---

Engagement and retention in mobile games has been researched. The conclusion of the research can be read below, the full research can be read in appendix 8.

The research concluded that the following features are important to keep the engagement and the retention rate high.

- Onboarding
  - This helps the user understand the app. It should focus on the primary goal of the app.
- Incentives
  - The users should get rewards for their actions.
- Push notifications

- Push notifications help with the retention rate, and it is important to keep them personal and not intrusive.
- Personal interactions
  - Social interaction can be created with goals, operators and feedback. The user should also be able to express him/herself in the app
- Social interaction
  - Social interactions can be promoted by giving the user the right communication tools to “play” with other users.

## 5.4 Creation process

### 5.4.1 Brainstorming and sketching screens

Together with the designer of the company and my supervisor, a concept definition has been created. **Sketching** was used to visualize the different features of the app. Appendix 11 contains the sketches and a summary of the brainstorm.

#### Step 1 - Onboarding

As advised by the company and chapter 5.3, the app should start with an onboarding. The onboarding should contain enough information for the users to understand the game, but not too much to overthrow the users. In the concept, this is executed by only showing basics of the app, as sketched in figure 4.

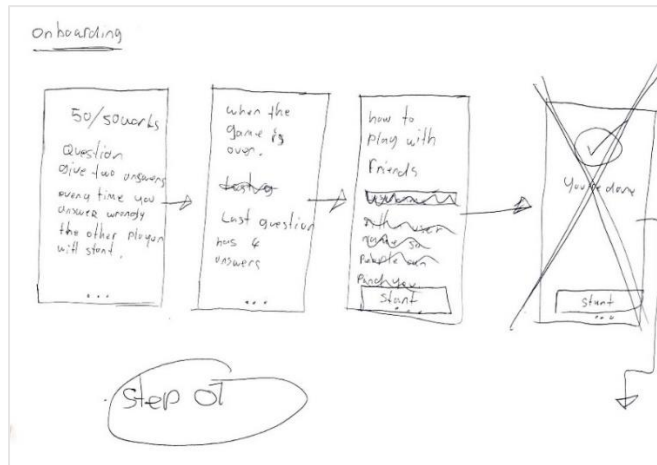


Figure 4 Sketch onboarding



## Step 2 - Login procedure

To keep the login procedure simple, a so-called “code-login” will be used. With the code-login method, the user does not have to remember a password while still being able to create an account (Figure 5).

Users should be able to choose their username and choose their avatar as this will increase personalisation.

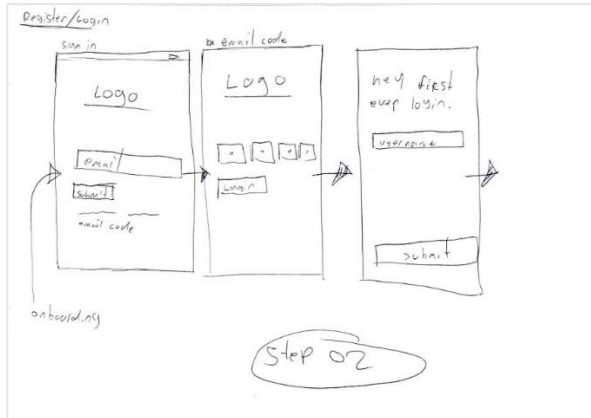


Figure 5 Sketch code login

## Step 3 – Home screen

In the home screen, users should be able to see the current games, and when the player does not have any active games, it should provide the user with information on how to start a game.

To make the games creation process as easy as possible. A big button with “start a game” should be present on the screen. This button should provide the option to either search for a match with a random user, or to search for a friend (figure 6).

The ability to invite a specific person will increase the social aspect of the game, which will increase the engagement, as explained in chapter 5.3.

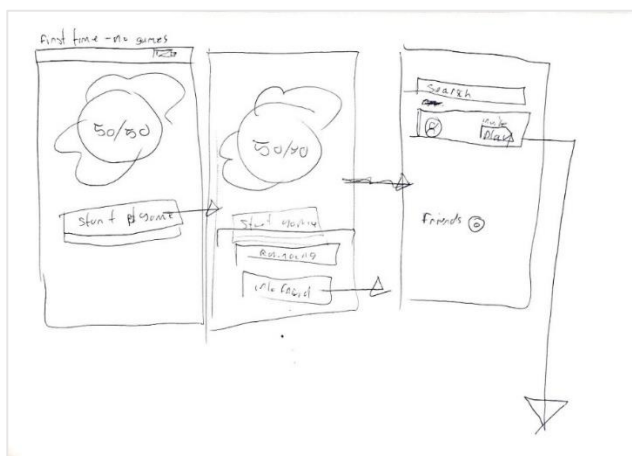


Figure 6 Sketch home screen

#### Step 4 – Games screen

The overview-screen should only provide the information the users needs at that moment in time. This is to keep the UI intuitive and straightforward.

The game overview, also called the roadmap, shows the question of the selected match. The current question is highlighted to make it more visible. Already answered questions should have visual marking so the user can instantly and intuitively see the status of a question.

Figure 7 is a sketch of this screen.

Pressing an item in this list will open the details page of the question. In this screen, the user can see the given answer or if it is his/her turn, to answer the question.

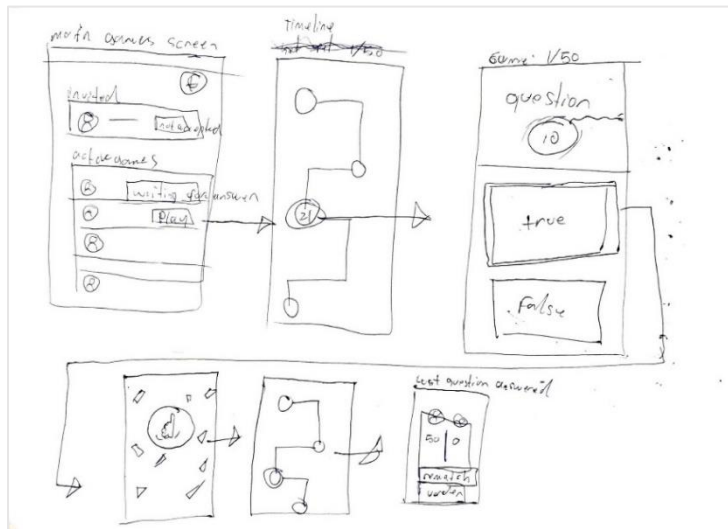


Figure 7 Sketch roadmap

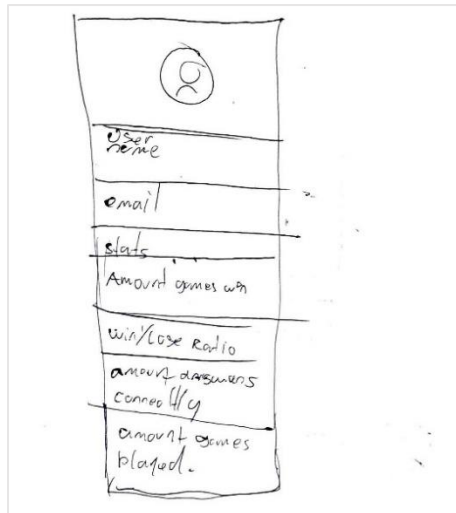
#### Step 5 – Profile screen

In the profile screen, the user should be able to see their email, username and be able to change their username and profile picture.

Besides general information, the screen should also provide information about their game statistics like score and matches played (figure 8).

As explained in chapter 5.3, the social aspect and the personalisation of an app is essential for the engagement. To increase the personalisation aspect of the game, all players will have a profile picture.

Users should be able to see the profile of another player were players can compare their statistics. This will improve the social interaction aspect of the app.



**Figure 8 Sketch profile screen**

## 5.4.2 Core game concept

---

The core game concept of the game is similar to the Dutch television program 50/50, as this were the wishes of the client. The game concept consists of a turn-based quiz. In this quiz, two players will play against each other in a variety of different question. It starts by choosing a random starting player. This player will be asked a trivia question with two possible answers. When answered correctly, he/she can proceed to the next question. When incorrect, the other player gets the next question. The person who answers the last question correctly wins the game.

The full game concept with all the game rules can be read in appendix 12.

## 5.4.3 Translation to mobile game

---

To transform the concept into a mobile game, additional features have been defined. Brainstorming and sketching have been used to define the features. (Appendix 11).

According to the theory in chapter 3 and chapter 5.3, the following features are essential for the creation of a successful mobile game. Below each feature is explained how this is implemented in the concept.

### 5.4.3.1 Onboarding

By making use of a short but effective onboarding, the users will not perceive it as annoying and still get the relevant information. After the onboarding, the user can log in through a code login system as described in 5.4.1. Users that already know the game can also skip the onboarding.

### 5.4.3.2 Reward system

#### Coins

The app will have in-game coins that the user will receive when answering a question correctly. The user will be able to collect these coins and will be shown on their profile page.

### **Player level**

The more the player plays the game, the higher the level of the player will be. This number of matches played will define the level of the player. The level of the player is displayed in the profile screen of the player; this way other people can also see the level of the player and will trigger players to level-up. The player level will act as a goal for the player and can be used to impress his/her friends.

#### **5.4.3.3 Notification system**

There will be two kinds of notification system in the app. One system provides push-notifications for game-related notifications, like when it is the player turn or match has been found. These notifications are necessary for the functionality of the game.

The other system will send notifications to players that have not been seen in a while. These are also called “campaigns”. These campaigns will help get the players back to the game and therefore help to keep the retention rate high.

Chapter 7 will explain how this system works.

#### **5.4.3.4 Personalisation**

To make the game more personal, the users will be able to change their username at any time. The user will also be able to change their avatar/profile picture to give a more personal feel. Push notifications will also address the users by its username to speak to the user more directly.

#### **5.4.3.5 Social interaction**

The following features are added to the concept to improve the social aspect of the game.

##### **Favourites**

The players will be able to search for other players and add them to their favourites

##### **Profile screen**

Players will be able to see each other profile screen where their statistics and level will be compared. The comparison of statistics will increase competition between the players.

##### **Inviting people**

Players will be able to invite other players, this way players can play with specific friends or people they want to play with.

##### **Chat**

In a match, the players should be able to send chat messages to each other to talk about the questions or to remind them they need to play.

#### **5.4.3.6 Monetization system**

As explained in chapter 3 and 5.3, the best approach for the app will for it to be free to play. Different methods of monetization will be used to make a profit of a free app. The first method is by in-app purchases; players can use the coins they won during the matches to buy in-game items. Players can also purchase these coins with real money.

Multiple ideas for in-game items are shown in appendix 12.

Besides in-game purchases, the app can make use of advertisement; after every match, the player can see a video-advertisement to continue playing. For users that don't want

advertisements, they can purchase a premium account. Ads will not be visible to premium users. Premium users will also get a new status in their profile to show other people they are premium users as this will trigger other users to buy premium.

## 5.5 Conclusion – Answer sub-question 1

For an app to be successful, it needs to follow a few guidelines. The best way of monetisation is to make use of the Free-to-play concept. This concept has been proven to make more revenue than the premium approach. To make this method successful, the engagement of the users need to be high. By combining multiple monetizing options like, in-app purchases with the possibility to buy a premium account, the app has enough potential to become profitable.

The in-game purchases should not give the paying players a too big of an advantage, or the game will lose the non-paying players. When a player buys in-game items, he/she should be able to show them to the other users as a sign of status. This will also trigger other users to make in-game purchases. When advertisements are used, it is important to give the player Experience of coins for sitting through the advertisement. This will prevent players from clicking away from the add.

By making use of different techniques to keep user engagement high, the app has the best potential to become popular and retain its users.

The techniques that are used in the Fifty Fifty concept are:

- A good onboarding
- Reward system
- Notification system.
- Personalisation
- Personal interaction
- Social interaction

# Designing

## 6 How to make an app easy and appealing to use?

### 6.1 Goal

The goal of this sub-question is to find out how to make an UI easy to understand and appealing for the user. This question will help with the choices that are made to create the design.

### 6.2 Method

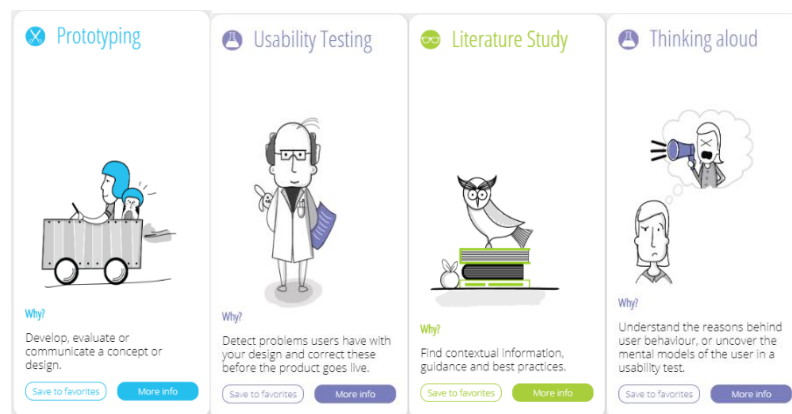


Figure 9 Methods used in this chapter

To answer this question, a **literature** study on UI design has been conducted. **Hi-Fi digital prototypes** have been used to test the design of the app. The prototype has been tested with a **usability test** combined with the **thinking aloud** method. The used methods are represented in Figure 9.

### 6.3 Results theory

#### 6.3.1 Gestalt and heuristics evaluations

Necessary features for intuitive design has been researched. The research will be used while creating design decisions. The full research can be found in appendix 13.

From the research, can be concluded that the Gestalt theory and the heuristic evaluation from Nielsen (Nielsen, 2014) are two of the main aspect that a designer needs to use when creating an intuitive design (Rizki Mardita, 2017). The gestalt principles are fundamentals for designing, and the Nielson heuristic can be used to evaluate the design.

## 6.4 Designing, prototyping and testing

### 6.4.1 First UI design

Figma was used to create the design of the UI and prototype of the design. Figma is a designing tool that makes it possible to create clickable prototypes of the design. Figma was chosen because the company uses this as their default design program. I never used Figma before, but I had some experience with Adobe XD. The similarities between the two tools made it possible to start using the software without too much trouble. Appendix 18 shows all the screens of the design.

#### 6.4.1.1 Inspiration

To get started with the design and to get a feeling of quiz apps, inspiration on different UI elements has been searched. The findings were put on a canvas in Figma for easy access. See figure 10.

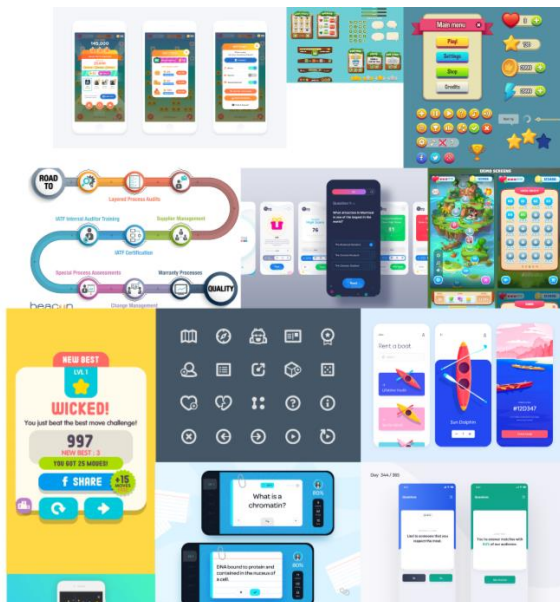


Figure 10 part of the inspiration canvas

#### 6.4.1.2 Home screen

The first design of the home screen is shown in figure 11. The navigation buttons are at the bottom to make it easy to navigate. When the player has no games, an arrow will be point to the add game button. This is to help the users navigate the app.

The items in the screen go in order from the need for action. With invites on top and an item that indicates that a game is searching at the bottom. To indicate the status of the screen, what is necessary according to the Nielsen heuristics (Nielsen, 2014) , the icon of the selected menu will get filled white, instead of an outline.

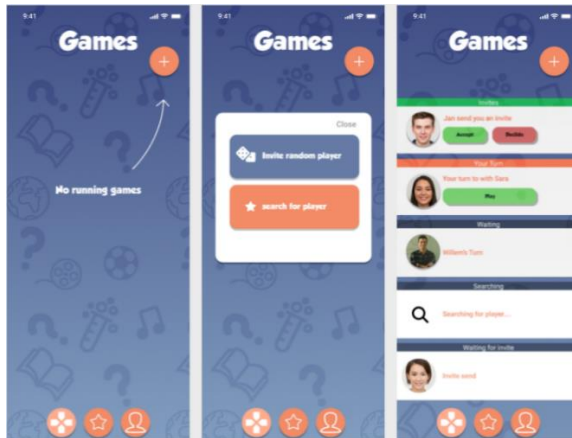


Figure 11 Design 1 home screen

#### 6.4.1.3 Profile screen

Figure 12 shows the design of the profile screen. To only show the essential functionality and to keep the design clear, the settings were moved to a different screen. This screen can be accessed by pressing the gear icon on the profile.

Icons have been used to show the statistics intuitively. The wins are shown inside the trophy where the user can see the games played and games won. The correct and incorrect answers are displayed in medals.

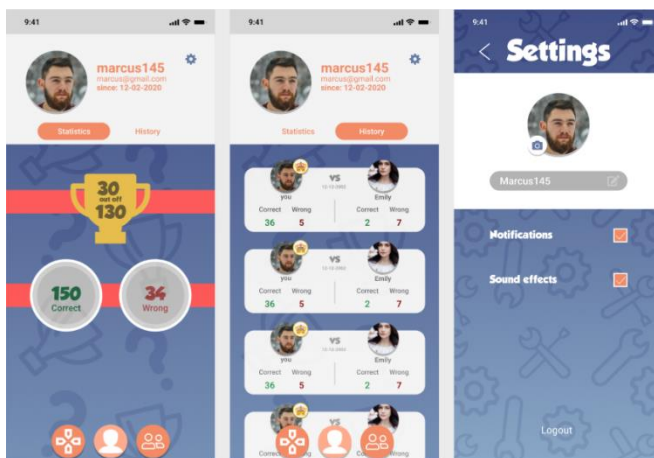


Figure 12 Design 1 Profile screen

#### 6.4.1.4 Friends list/screen

The design of the friends list/screen is shown in figure 13. A search bar is added at the top of the screen so users can easily search for players. In the list, the user can invite a friend to play a game and see if an invite has already been sent. Invitations are on the top of the list because they need the interaction of the user. When clicking on the profile picture of a user, their profile screen will open. In this screen, the statistics of the user are displayed to encourage competition. To increase in social interaction, as explained in chapter 5, the user can send a friend request to the other player from this screen.



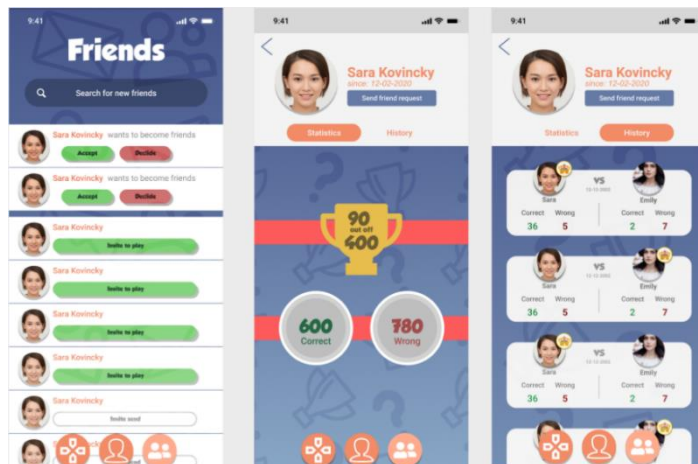


Figure 13 Design 1 friends list and screen

#### 6.4.1.5 Game overview page

The overview page design is shown in figure 14. With the first question at the top, scrolling down to the last question.

To easily indicate which user needs to answer which question, their profile picture is displayed next to it, which used the grouping principle from gestalt (appendix 13).

By making use of the colour green for correct and red for incorrect, the user can easily see the status of a question.

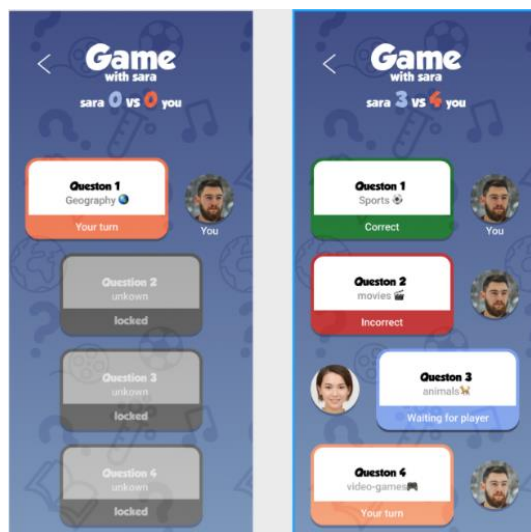


Figure 14 Design 1 roadmap

#### 6.4.1.6 Question page

To give a feeling of actually answering a trivia question, the questions will be displayed on a trivia card as is shown in figure 15. This card will flip, revealing the question and starting the timer. Depending on if the question is correct or not, a pop-up will appear informing the user about the status of the question, as according to the Nielsen heuristics, visual conformation makes a design more user friendly.

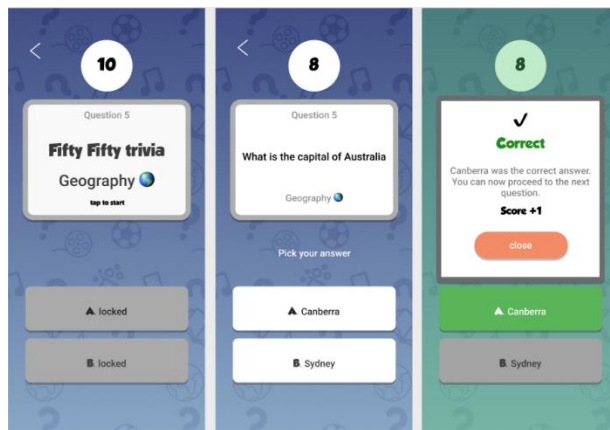


Figure 15 Design 1 question screen

#### 6.4.1.7 Onboarding

Figure 16 shows the first design of the onboarding. Screenshots of the app are included in the onboarding to make it more intuitive. This reduces the amount of text needed and will shorten the onboarding, which is necessary according to the theory of chapter 5.

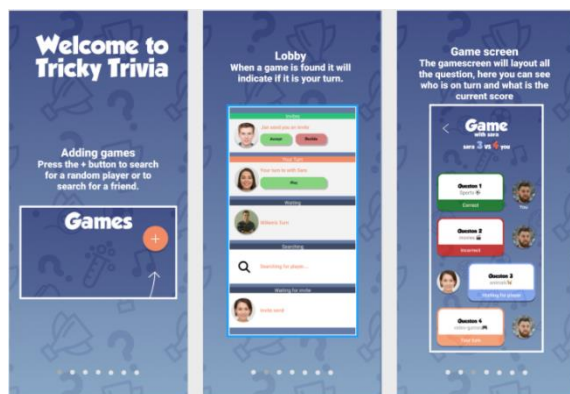


Figure 16 Design 1 onboarding

### 6.4.2 Usability testing

To create the prototype, the Figma clickable wireframe functionality was used.

#### 6.4.2.1 Testing (think aloud and usability)

All the developers of Appnormal were invited to test the prototype.

The developers were asked to perform the following tasks and **think aloud** while performing.

- Login
- Find a random match
- Answer question random match
- Add a player to your favourites
- Change your nickname

Figure 17 shows the results of the test.

The key remarks of the test were:

- All profile pictures need to be clickable.
- When you have a question correct, you should automatically go the next question.
- The favourite icon is not clear.
- Score of the match is not clear.
- Almost everybody goes to the profile screen instead of the friend screen.

The full report, including a higher resolution version of figure 17, can be found in appendix 14.



**Figure 17 Results usability test of prototype 1**

### 6.4.3 Consultation Appnormal

#### 6.4.3.1 Designer's input

The designer of the company was instructed to help with the design of the app. Because the designer was also there for the brainstorm meeting (Appendix 11), we had the same ideas for what kind of screen should be created and what features should be visible on the different screens. Figure 18 shows a part of his design. The full design can be found in appendix 19.

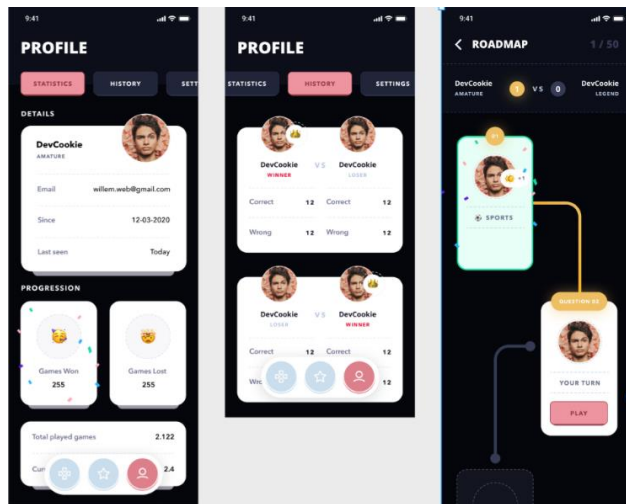


Figure 18 Part of Appnormals design

#### 6.4.3.2 Client's view

In a meeting with the client, designer and my supervisor (appendix 15), the different designs and the created prototype were discussed. The designer and client commented that they liked the flow of my design. The client commented that the look and feel of Appnormal design was more suitable for the app as it looked and felt more appealing.

The client wanted to get a combination of both the designs. The new design should consist of the visuals of Appnormals design but the results of the usability test in mind. Because Appnormal design only consisted of a few screens, all other screens needed to be remade in the new visual language.

#### 6.4.4 Combining, prototyping and testing

With the information of the client and the information gathered during the usability tests, a combination of both the design could be made. The new design is also visible in appendix 20.

##### 6.4.4.1 New home screen

The new home screen is visible in figure 19. The results of the usability test also concluded that the menu at the bottom was too visible compared to the functionality of the buttons. The "add button" should be the main point of attraction. For this reason, the navigation buttons were swapped with the add button.

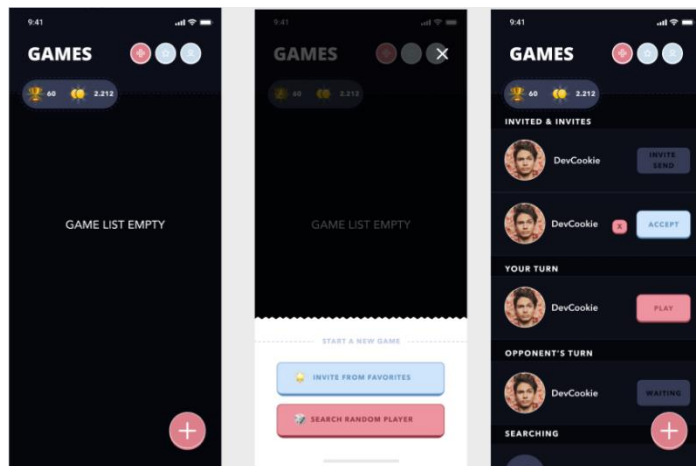


Figure 19 New design home screen

#### 6.4.4.2 New profile screen

The new profile screen is shown in figure 20.

To be consistent, the profile screen also has the navigation buttons at the top of the screen. Because the usability test concluded that the settings were a bit hard to find, the placing as in the first design has not been reused. The profile screen itself has the same functionality as in the first design, as most testers found it easy to use, only now with the looks and feels of the new design.

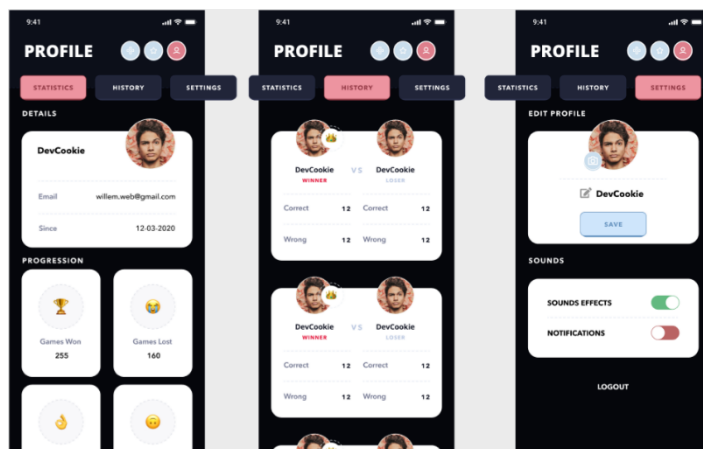


Figure 20 New design profile screen

#### 6.4.4.3 New favourite list

The new design is shown in figure 21. To reduce redundant information on the screen, the search bar has been removed from the list, as the user does not always want to search for new player. A floating action button has been added to open the search page.

In the usability test, users got confused by the icon for the friends. For this reason, the icon has changed to a star.

The friend request feature has been removed from the design, as in the testing users commented that it would be more useful to favourite people without the need of the other player to accept it, as it adds a new action and increases complexity.

To make it easier and more intuitive to compare statistics with another player. The values are displayed directly next to each other, as efficiency is one of the Nielsen heuristics.

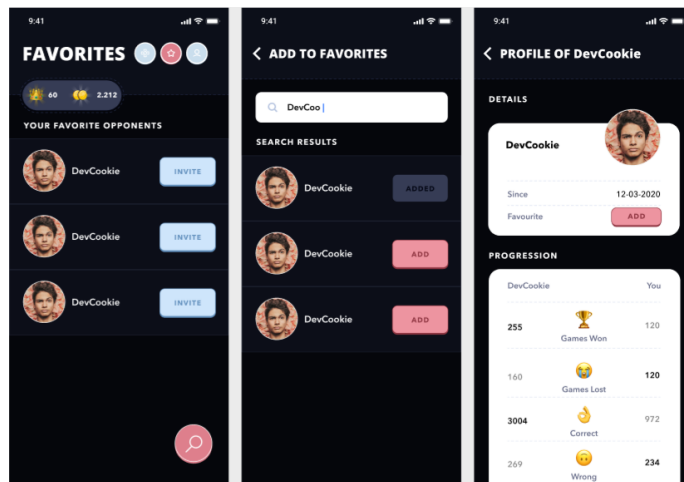


Figure 21 New design favourite list and screen

#### 6.4.4.4 Game overview

The design of Appnormal took to much space, resulting in unnecessarily scrolling. The reduce in amount of screen space will help satisfy the requirement of the app being compatible with different screen ratios. This has been completed by combining the layout of my design with the visuals of Appnormal design. Figure 22 shows the difference.

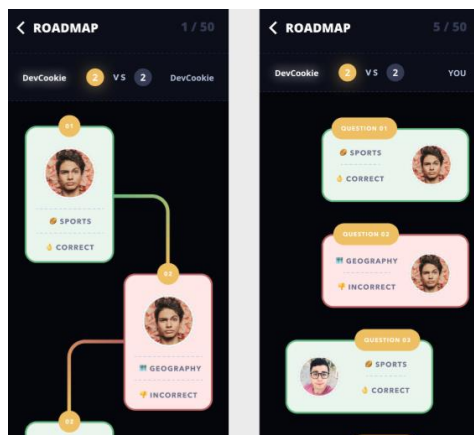


Figure 22 New design roadmap (left original, right new)

#### 6.4.4.5 Question screen

Because the users liked the visual confirmation, the pop-up has been reused. In addition, the background and the button on the page will change colour according to the status of the question and will remain this colour even if the pop-up is closed. This improves the ability to see if a question is correct or not easily. A next question button has been added, as most of the users did not want to go back to the overview to go to the next question, as is shown in figure 23.

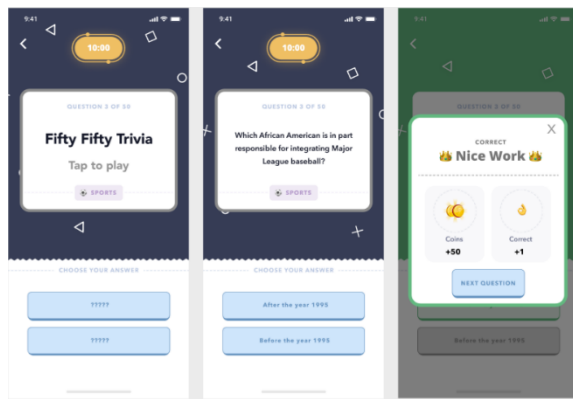


Figure 23 New design question screen

#### 6.4.4.6 Onboarding

The new onboarding is shorter because the test concluded that some users found it a bit long. Because the user still needs to be informed about the use of the app, additional hints like “press here to add a game” are added in the app itself. The arrow pointing to the “plus button” has also been removed because in the usability test users kept pressing this button. The new design is shown in figure 24.

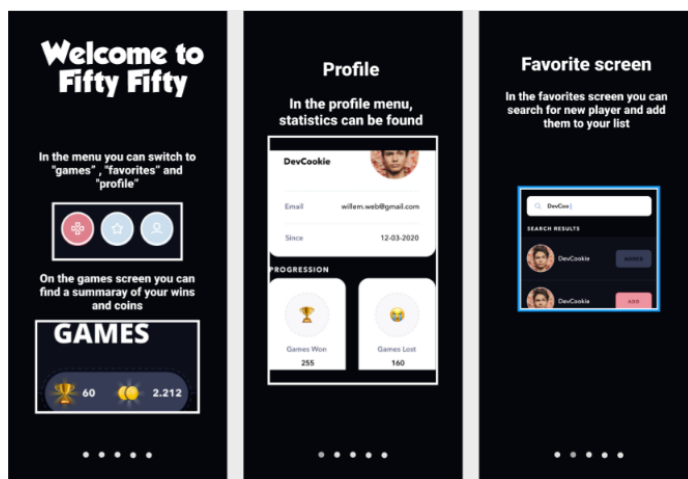


Figure 24 New design onboarding

#### 6.4.4.7 Meeting

After the design has been created, it has been discussed with the designer and my supervisor (Appendix 16). This design provided enough information to continue with the functional prototype. Additional feedback like the alignment of text and buttons should be fixed in the functional prototype but are unnecessary to fix in the Figma project, as this is only a reference for the product. To keep the app design playful the background icons from the first design can be added in the functional prototype.

## 6.5 Conclusion – answer sub-question 2

Making the interface appealing and easy to use; the designer can make use of multiple design principles as the gestalt theory and Nielsen heuristics. During the development of the design, it should be user-tested to see if the users actually can use the interface without too many instructions.

A user interface is a collection of interactions. These interactions should all fit each other and not confuse the user. When the interactions are disconnected from each other, the user can be confused and does not know what to do.

The combination of testing and iterating will create a more intuitive interface which will be more appealing for the user. Figma is an excellent tool for designing, prototyping and makes it easy to convert a design in a clickable prototype.



# Prototyping

## 7 How to develop a functional prototype that is valuable for Appnormal?

### 7.1 Goal

The goals of this sub-question are to find out the best way to create a working prototype what will be useable for the company. With this information, a functional prototype will be developed.

### 7.2 Methods

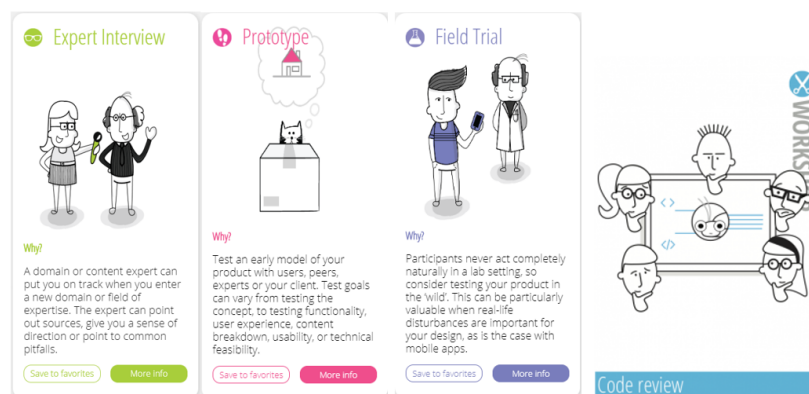


Figure 25 Methods used in this chapter

The used methods are represented in figure 25. An **expert interview** has been conducted to find the best approach for the development. **Prototyping** is used to test the features of the game in a functional prototype. During the development, **code reviews** have been conducted to assure that the prototypes meet the companies standards. After finishing the prototype, a **field trial** has been done to see how the app works in the field.

### 7.3 Results Theory

#### 7.3.1 Code collaboration research

This research will give insight on how to work on a app development project effectively.

##### 7.3.1.1 Code standards (literature research)

Code standards exist so that all developers that work on the same project use the same set of guidelines. When all the developers use these guidelines, it is easier for all the developers to read and work with the code that someone else wrote. Consistency has a positive impact on the quality and maintainability of the system.

Besides the positive effects it has on the developers, good coding standards also helps to prevent security and performance issues. (Ed., 2020)

### 7.3.2 Flutter code version control

The make the code available for the company; their own **GitLab** server is used. By making use of Git, the company will have a working history of the code for each feature in the product. With this history, it is possible to roll-back to an older version, or to take fragments of code out the previous versions.

### 7.3.3 Sprints

An interview with Roy van der Veen (developer) has been conducted on what would be the best approach for the functional prototype (Appendix 17). The conclusion is that the development should be divided into different sprints, each sprint creating different features and solving different problems.

## 7.4 Development sprints back-end

### 7.4.1 Database structure/start of the project

The first sprint of creating the back-end is to design a database structure. During the interview (Appendix 17) a database structure has been created. The figure below shows how the database structure should be.

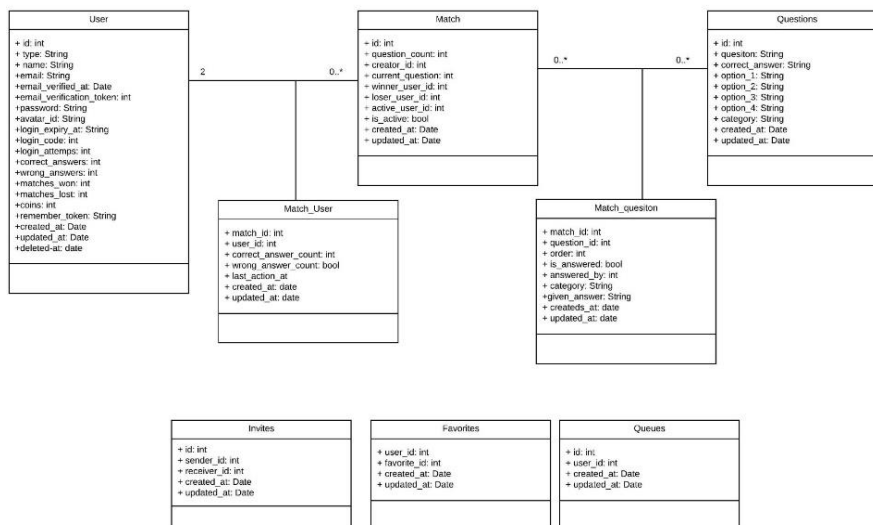


Figure 26 chosen database structure (see appendix 17 for full image)

With the chosen database structure, it is easy for Appnormal to make changes to the application. By keeping the game functionality in the back-end, Appnormal can tweak settings like the number of answers, without the need of releasing a new version of the app.

### 7.4.2 Project set-up and Docker

The company uses Docker for its servers. Docker is a software tool that helps developers run multiple servers in their own container. This makes it easy to run different software versions on the same server (Docker, 2020).

To test the back-end, it needs to run on a local machine; this will provide instant changes when the code is altered instead of waiting for a server to update. This makes it faster and easier to test the server with the Flutter prototype. At first there was some trouble setting up Docker, but with the help of the Docker expert at the company, we managed to get it working.

### 7.4.3 API calls

---

Following the advice of the company, the back-end will make use of the generic-Laravel project. The company has experience working with this project, so continue working with this structure will be straightforward for the company.

Laravel makes use of so-called “routes” to define the endpoints for the API. Each route calls a specific function where a specific method is executed. Because it was my first time using Laravel I had quite a struggle starting with Laravel. I solved this issue by first diving into the generic project that already had an API call for the login. By deducting the code I tried replicating and customizing the methods to create the desired functions.

Besides looking into the code, I followed a crash course of Laravel development which took me around a week to complete and understand, the course I used is (Laracast, 2018). This course provided the basic knowledge to work on the project.

The list of all the created routes and methods are shown in appendix 21.

### 7.4.4 Postman testing

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Postman was used to test the functionality of the API. It was used a lot in the testing phase. The combination of the local server and postman provided direct feedback which made the development more effective as results were instantly visible. See appendix 22 for a more detailed postman explanation.

### 7.4.5 Push notifications

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Following the advice from Appnormal, Firebase cloud messaging is used to send the notification. When a notification is needed to be sent, the back-end will make contact with the Firebase console to send a message.

Besides the direct messages that are sent from the back-end, firebase also provides the possibility to send messages to a certain target group, like users that have not used the app in a while. This ability will be used to maintain user engagement, as explained in chapter 5. The automatic campaign will stop after four unopened messages to prevent annoying the user.

Figure 27 and 28 show the decision trees for the notifications. For readability both the figures are added in appendix 23.

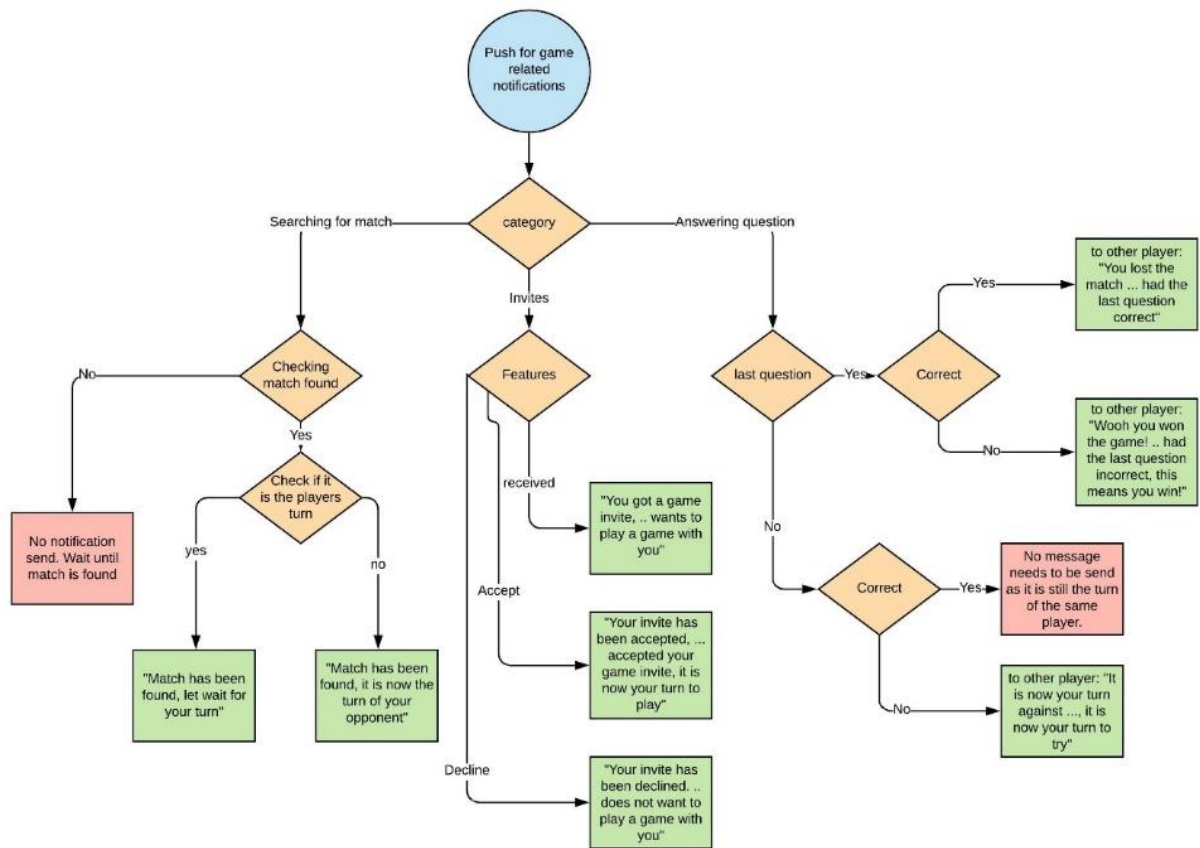


Figure 27 decision tree in game push

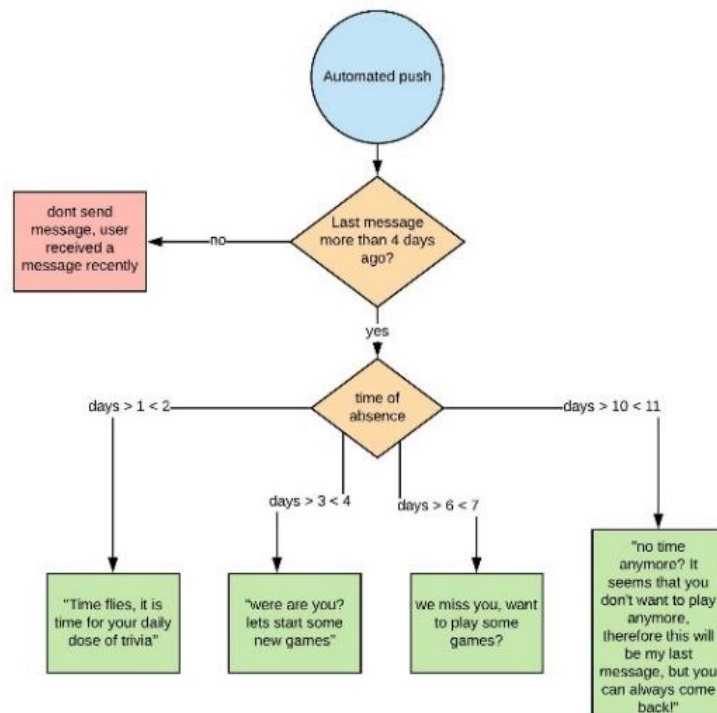


Figure 28 decision tree campaign push

## 7.5 Development sprints front-end

### 7.5.1 Onboarding sprint

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To ensure the quality, Appnormals generic Flutter project has been used for the project.

To get started with Flutter I followed this course on Flutter (Angela Yu, 2019). This course was chosen because it was free and recommended by the official Flutter documentation.

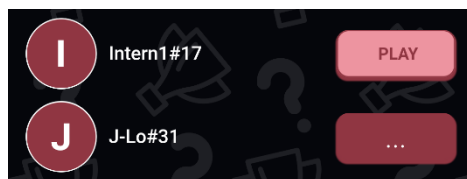
With the basic knowledge of Flutter the onboarding has been created. A mock-up for the onboarding was present in the generic project. This mock-up has been altered to the needs of the project.

### 7.5.2 Recreating UI

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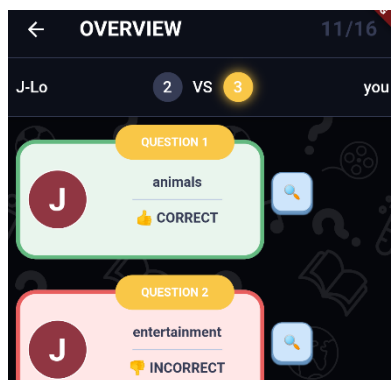
With more insight into how flutter works, different screens and UI elements were recreated in Flutter. Starting with the most simple pages that do not require much functionality.

According to chapter 6.3, the app needs to provide the user with as much feedback as possible. To provide this, on all places the app is loading, a loading indicator has been added. This will inform the user of the loading process and will confirm that the buttons have been pressed. Figure 29 shows an example of one of the in-game buttons showing an animation after pressing.



**Figure 29** Example button animation

A big part of the UI is the roadmap. An additional button is added to revisit a question; this is shown in figure 30. This button makes it more visible that a question can be inspected.



**Figure 30** inspect button roadmap

According to chapter 6.3, every system or app should inform the user when something goes wrong or right. Especially when something goes wrong, the error should be human-readable instead of an error code. Figure 31 shows an example of an error and a success message.

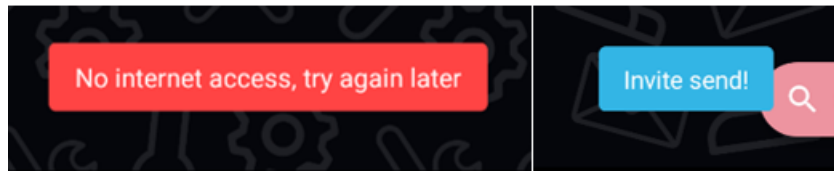


Figure 31 readable error

### 7.5.3 Functionality and API

After creating the UI, the API needed to be implemented. The API calls were already tested in Postman this showed they were working, just not yet in the prototype.

The app contains a lot of different API calls, which made it hard to keep track of the code. The **code reviews** helped to understand the code better and made the product more reusable. To keep the code as clear as possible, the different screens were coded separately as much as possible.

During the meeting with the client (Appendix 15) was concluded that the app needs to have the ability to support multiple languages. Appnormal already has a localization plugin in their project loads different language sets, depending on the device settings. To properly implement this feature, every sentence that is visible in the app is provided in English and Dutch. An example of this is shown in figure 32.

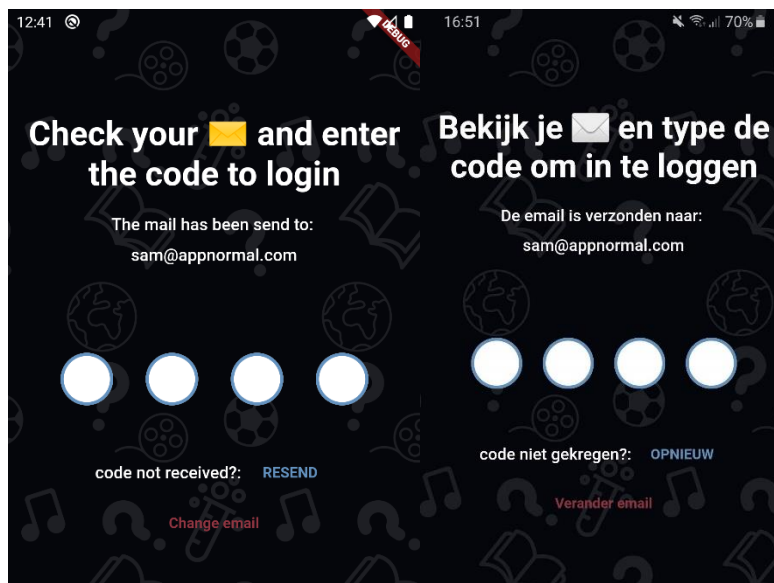


Figure 32 Localisation Flutter

### 7.5.4 Push notifications

As described in the theory of chapter 5, push notifications are an important feature that will help with user retention and is a feature that is needed for the game to function correctly. The messages will inform the user of new events in the game when these messages are clicked the game will refresh. Figure 33 shows the push message and figure 34 shows the result in the app.

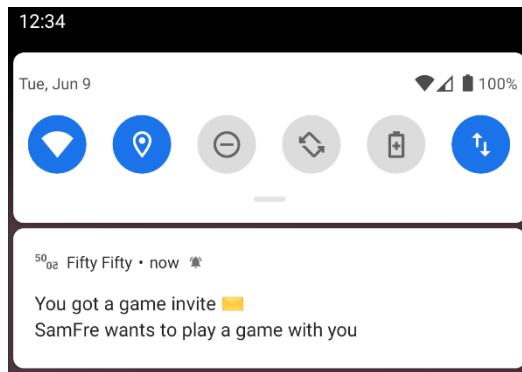


Figure 33 Push example

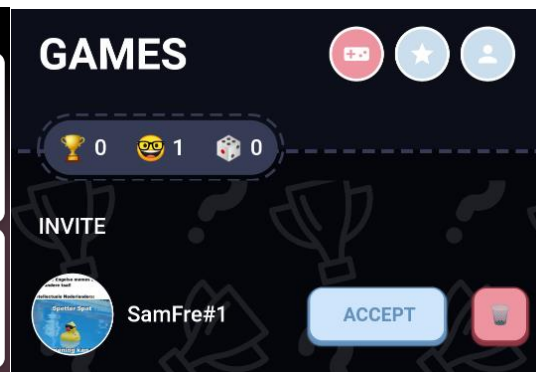


Figure 34 Push result app

The push notification system was not one of the most complex, but certainly the most time-consuming feature of the app. It went smooth on Android, iOS on the other hand, is a lot stricter in the exact configurations. This means that it can work perfectly fine on android, but once exported to iOS, nothing happens. Because I did not have an iOS device and the iOS simulator does not support push messages, testing was rather hard to do. Due to the Covid-19 lockdown, I only on occasion could go to the company to test on a real iOS device. Eventually, with the help of several colleges, we managed to get it working on iOS.

### 7.5.5 Quality, refactoring and code reviews

During the development of the functional prototype, multiple code reviews helped with the readability and reusability of the app. During these reviews, we searched for potential bugs and improvements.

Code reviews make bugs visible in an early stage, which makes it possible to fix issues when there is still time to do so.

### 7.5.6 Testing (Field trail)

The final test of the prototype was testing it with the team of Appnormal. This test would show how the app behaves in the “real world” or a so-called **field trail**.

The full results of this test are shown in appendix 24.

The key remarks of the test are as follows:

- Some iOS devices were not getting push messages, but the game functionality was working.
- When getting a question correct, the app does not automatically go to the next question
- The app is not spam-proof, users could put themselves in the queue a significant amount of time and with this spamming the matchmaking process.
- There are performance issues in specific screens
- Keyboard not showing up on some devices.
- Missing popup for confirmation choice.

The test has revealed bugs as well as new insights on how the users could abuse the system.

Besides the bugs and some UI faults, Appnormal was happy with the test. People could play the game and some of them were (two weeks later) still playing the game with each other.

## 7.6 Conclusion – answer sub-question 3

The answer to “How to create a prototype that is valuable for Appnormal?” has to do with various parts of the development. The essential elements for creating a valuable prototype are for Appnormal were:

### **Version control**

With **Git** as version control, the company can roll-back any changes they do not want without affecting the product. This way Appnormal can easily take over the prototype that is created.

### **Default projects**

By making use of the default project of the company, it is easier for Appnormal to continue developing the project because they are familiar with the project structure.

### **Code reviewing**

The code reviews help with the insurance of the quality of the code and show where improvement is needed.

### **Testing**

The prototype should be tested with end-users to find bugs that would not have been found without the testing. Besides bugs, the test also reveals insights on how the user uses the app and could exploit the app. These bugs need documentation so the company can work these out before the launch of the product.

### **Working features**

The working features of the app are as follows.

- Onboarding
- Login system
- Sending invites
- Playing a game
- Push notifications
- Search users
- Search random user
- Compare statistics
- Favourite users
- Upload an avatar
- Update username
- Logout functionality
- Accepting invites
- Game history list with answers



8 Conclusion

9 Discussion

10 Recommendations

## 8 Conclusion

First, the sub-questions need to be answered to answer the main question.

### **How does an app become successful and profitable?**

The app should be free to download and use for any player, and it needs to be available on both iOS and Android to reach the maximum amount of users. A combination of in-game purchases, advertisements and a premium account will provide the possibility for maximum profit. The in-game purchases must not give an in-game advantage over the non-paying players as this will push away non paying players. The users need to be rewarded for their playtime to keep them coming back. Push notifications will also help to keep the retention rate high.

### **How to make an app easy and appealing to use?**

There are several heuristics and design principles that can be used when creating a user interface. The gestalt principles and the Nielsen heuristics can help with making design decisions. The design needs to be tested with the user to remove bottlenecks and get feedback for improvements. Iteration with the feedback in mind will help to create an intuitive and appealing design.

### **How to develop a functional prototype that is valuable for Appnormal?**

Using the generic projects of Appnormal will help with the reusability of the prototype. Besides reusability, making use of generic projects will also make it easier for Appnormal to help fix bugs when needed. Code reviews help to keep Appnormal up to date with the process and will improve the readability and reusability of the code.

### **How to develop a prototype of an online multiplayer trivia app that is ready for further development and attracts users from 20 to 40 years old in the mobile game market?**

The mobile game can be marketed for a broad audience because of the universal design decisions. The purpose of Fifty Fifty is to give a fun and addicting experience to the users to keep them returning to make more hours in the game.

The multiplayer aspect of the game gives the users motivation to challenge other people and compare their statistics with the other people.

The user can personalise their profile which will make the user more attached to the game, which will increase the retention rate of the game.

By making use of personalised incentives, the user will be drawn toward the app and feel personally asked to play the game.

The combination of a multiplayer challenge, personalisation and incentives will result in a high retention rate which can be used to make monetisation effective.

A video of the final product can be opened through the following links:

Vimeo: <https://vimeo.com/428817609>

YouTube: [https://youtu.be/0LykBPp\\_32U](https://youtu.be/0LykBPp_32U)

## 9 Discussion

This chapter will contain points of discussion, chances, limitations and advice for follow-up research

### 9.1.1 Results and expectation

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The final product has a fully working game functionality. As expected, the product does not have a working implementation of in-game purchases and advertisements.

The game is playable, but one core aspect of the concept where the user that can answer the last question, can choose to answer it or not, is not implemented. This is because of time limitations as the front-end and the back-end would need additional features.

### 9.1.2 New insights

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To create a full working back-end and front-end was quite a challenge. The prototype has a working front-end and back-end. But the quality would have been better if the graduation only focused one of those two.

Working on essentially two different products increased the development time dramatically as two new technologies needed to be learned instead of one.

Because of the Covid-19 virus, the time between code reviews was longer than usual, which resulted in more prominent feedback where more code needed to be changed, which led to more refactoring and more development time.

### 9.1.3 Explanations

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Because the company already defined a part of the concept, the conceptualizing phase did not change the main concept. This phase was used there to create additional elements what would transform the concept into a mobile game.

### 9.1.4 Limitations

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The Covid-19 virus made it harder to collaborate with the developers of the company. For this reason, the back-end is not worked out as neatly as I would have hoped.

Due to the Covid-19 lockdown, it was not as easy as usual when I was stuck with the development. Which increased the development time which already was pretty tight

### 9.1.5 Follow-up research

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For follow-up research, I would recommend looking more into marketing campaigns, as the product at the moment was more focused on the app itself instead of marketing the app.

# 10 Recommendations

The company wanted a list of recommendations to develop the product further. The recommendations can be found in appendix 26. These recommendations will help with the development of the final product, as these can be implemented to make it a more appealing and complete product.

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