Designing tutoring, feedback and gameplay of a mobile game

For pick-up-and-play and long-term playing

Anna Flisberg

Supervisor: Aseel Berglund
Examinator: Kristian Sandahl
Copyright

The publishers will keep this document online on the Internet - or its possible replacement - for a period of 25 years starting from the date of publication barring exceptional circumstances.

The online availability of the document implies permanent permission for anyone to read, to download, or to print out single copies for his/hers own use and to use it unchanged for non-commercial research and educational purpose. Subsequent transfers of copyright cannot revoke this permission. All other uses of the document are conditional upon the consent of the copyright owner. The publisher has taken technical and administrative measures to assure authenticity, security and accessibility.

According to intellectual property law the author has the right to be mentioned when his/her work is accessed as described above and to be protected against infringement.

For additional information about the Linköping University Electronic Press and its procedures for publication and for assurance of document integrity, please refer to its www home page: http://www.ep.liu.se/.

©Anna Flisberg
Abstract

The objective of this master thesis project was to improve the existing mobile game Entanglement. This game needed better tutoring and feedback, since the players found it hard to grasp how to play the game. The gameplay of the game also needed to be adjusted as it had no clear goal and did not keep the players’ interest.

Mobile games has exploded on the app market and the way they are composed differs from the more traditional games on gaming consoles and computers. This thesis has investigated what makes mobile games successful and what trends there are in the mobile gaming market. Focus has been on the tutoring, feedback and gameplay of mobile games.

The thesis project resulted in improved feedback to the player as he is playing Entanglement. The tutoring of the game has also been given a real boost although it needs continued work and user testing to get it to work optimally. The gameplay was changed to a level based gameplay, which gave the game a clear goal and easily kept the players interested. Entanglement is still not ready for release, but it has come a long way.
Acknowledgement

First and foremost I want to thank my supervisor Aseel Berglund for sensible discussions and great guidance. I also want to thank Erik Berglund for all the help with technical issues. Making this master thesis alone would have been much more difficult and boring without supervisors that I could bounce ideas off of.

I also want to thank my family and friends for their support and encouragement throughout the project. Finally, I thank Teodor Vik for having been there for me and always believing in me. For encouraging and pushing me to keep moving forward and to always do my best.

Thank you.
## List of Figures

2.1 Game prototype ........................................ 4  
2.2 Game tutorial ........................................... 5  
3.1 Visualized flow zone with challenge and ability as factors ..... 9  
4.1 Management application Trello .......................... 12  
5.1 Screenshots from Crossy Road ........................... 18  
5.2 Screenshots from Candy Crush Saga ...................... 19  
5.3 Help section in Candy Crush Saga ....................... 20  
5.4 Screenshots from Pyramid ............................... 20  
5.5 In-game purchases in King games ....................... 21  
5.6 JSON file structure for level information ............... 23  
5.7 Level based gameplay .................................... 23  
5.8 Feedback when player made mistake ..................... 24  
5.9 Winning and loosing screens ............................. 24  
5.10 Status bar ................................................ 25  
5.11 Newly produced graphical elements ..................... 25  
5.12 Introduction to the game mechanics, Part one .......... 26  
5.13 Introduction to the game mechanics, Part two .......... 26  
5.14 Results of questions asked in the final usability evaluation 27  
5.15 Results of subcategories from the final usability evaluation 27
List of Tables

3.1 Heuristics for evaluating the usability of a game design ........ 11
4.1 PSSUQ subcategories and the belonging statements ............ 16
5.1 Analysis of competing mobile games .......................... 17
Chapter 1

Introduction

Chapter One sets out the motivation and aim of this master thesis. It will describe the problems being investigated and define the delimitations and limitations set upon the work.

1.1 Motivation

With the introduction of the smartphone in the early 2000s, the gaming world changed. Today, playing games is not restricted to only playing on game consoles and computers, but also on mobile phones and tablets. This has opened up a whole new market for casual games, i.e. games that are easy to learn and easy to play on the go.

This new way of playing games is changing the conditions for the game makers an incredible deal. Not only are the dimensions of the screens much smaller; requiring more reflection on the interface, but the players also have a different way of thinking. A player playing a casual game on their mobile phone does not have the patience for a long tutorial. He wants to begin playing straight away.

The gameplay of mobile games differ from the gameplay of traditional games on game consoles or computers. The goals need to be clear and small, so that the game is enjoyable to play for a short period of times as well as for longer sessions. The interface must be simple and effective and, above all, must the feedback from the game work so well that the player never gets frustrated or bored. This is because a mobile game so easily can be replaced to no cost at all for the player.

1.2 Aim

The purpose of this master thesis is to find a better way to create meaningful tutoring, feedback and gameplay for a mobile game by studying academic research as well as existing game designs. The goal is to implement the findings into the existing game Entanglement and make it into a mobile game that users want to return to and play for longer sessions.
1.3 Research question

The following problems are investigated and answered in this thesis:

1. How can the gameplay of a mobile game be designed to create a pick-up and play as well as a long term playing attitude on the player part.

2. How can the tutoring of a mobile game be designed so that it does not interfere with the gameplay and maintains the player’s interest in the game.

3. How can the feedback in a mobile game be designed to create a good understanding of happenings.

1.4 Delimitations and limitations

This master thesis will not cover the promotion of the game, nor how the game should reach out to the masses. It will further not examine how advertising and in-game purchases will be perceived by the player. The thesis will also have limited user-testing, since the time for more extensive user testing is lacking.
Chapter 2

Background

Chapter Two shows the aims and results of the two previous studies that have been conducted around the creation and development of the mobile game Entanglement. Since this study intends to refine the resulting game prototype, the previous studies and their findings are of great importance.

2.1 Previous aims

The first study, [2], had the objective to create gameplay and game mechanics for a math learning game, with the target group being children in the early school age, where the player should not rely on luck. The study also examined the advantages and disadvantages of using a framework like Phaser.io, [16], instead of HTML5 and Javascript alone.

The second study, [20], had the objective to polish the mobile game and research what features create entertaining, successful games. It focused on developing the gameplay and content of the game, as well as building the code foundation of the game.

2.2 Previous results

The findings of the past two studies resulted in a game prototype, shown in Figure 2.1, built with the framework Phaser.io. The game uses Phaser’s built in states to navigate between different stages of the game. This along with classes implemented to handle such things as cards, player info and level generation is a good attempt to bring separation of concerns to the code. However, the code foundation is quite complicated and the lack of comments makes it hard to fully understand the code and to develop it.

The game is played by turning over pairs of cards. Each pair of cards has one visible number and one hidden number. Together, each pair has a predetermined sum, which is shown in the upper left corner of the game, see Figure 2.1B. The aim is to understand what the hidden numbers are, and to pair them with cards that have that same number visible on them. The player gets points for each pair that is paired correctly.

Each game is restricted to 60 seconds. The goal is to beat your own high score, and to get enough points to level up. At each score level the player gets a
new icon, shown in the upper left corner of Figures 2.1A and 2.1C. Some score levels are also barriers to unlock higher game levels. These levels have the same gameplay but the sum that the pairs adds up to is greater. The player can choose which level to play from the menu, shown in Figure 2.1A.

The feedback from the game is quite poor. If the player happens to miss a possible pairing, or if he pairs two cards incorrectly, all cards turn momentarily gray and then the player is given a new set of cards. No text, or sign of what the player did wrong is shown. When the player runs out of time, he is shown a screen with the statistics of the game he just played. This screen also tells if the player leveled up or if he beat his highscore. Then the player is returned to the game menu.

The first time the player starts the game he is shown a tutorial which explains how to play the game. He is first introduced to the controls of the game by a text advising him to press a card to turn a pair, Figure 2.2A. He is then informed that each pair of cards has a predetermined sum, as shown in Figure 2.2B, and asked to keep turning over more cards. The player is introduced to the aim of the game as shown in Figure 2.2C. When a solution is possible, a text saying: "A solution is possible!" is shown. When the player makes a correct paring, a text shows that says "Congratulations!", but nothing more than that.
Chapter 2. Background

(A) Explaining flip  
(B) Explaining sum  
(C) Explaining pairing

Figure 2.2: Game tutorial
Chapter 3

Theory

Chapter Three contains the result of the academic research done at the beginning of the project. It contains the theoretical material that formed the basis for this thesis and the methods used. It also provides background for both the user experience and the game design.

3.1 Usability

The international Organization of Standardization (ISO 9241-11) defines usability as:

“Extent to which a product can be used by specific users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use.”

Usability is most often talked about when developing user interfaces for a system, but is equally applicable when developing mobile games. A mobile game is basically a user interface that the player must understand and use to achieve a specific goal - winning the game. However, the usability of a game differs a little from the usability of a system’s user interface. Tutoring, for example, is a common part of a game, but in a system, it is rarely acceptable with a tutorial to be able to understand how to use the interface.

3.2 Player experience

The gaming experience indicates what the player feels during his time spent playing the game. It is an attempt to categorize the positive and negative feelings for the game. It is the player experience that determines whether the player will continue to play or stop playing the game.

3.2.1 Pick-up and play

A pick-up-and-play game is defined by having a low threshold for understanding the game play. It has clear and easy controls and objectives, and a small learning curve. Complicated, large scale games that require the player to memorize controls and read a manual to understand the game objectives does not fall into the pick-up-and-play category.
Chapter 3. Theory

When developing a mobile game, the pick-up-and-play effect is crucial. Users playing on their mobile devices do not have the patience to learn a new game. They do not want to read a manual to be able to understand the game play. Instead, in-game help is preferred [14].

3.2.2 Flow

Flow is the mental state when a person performing an activity is fully immersed in a feeling of energized focus, full involvement, and enjoyment. The person goes beyond his reflective self awareness and at the same time has a deep sense of control. In essence, flow is characterized by complete absorption in what one does. Achieving flow is often referred to as being in the zone.

Since flow is completely focused motivation and determination, it is seen as the ultimate mental state for performing and learning [17]. Flow leads to further involvement in challenging activities because the individual must place increasingly higher standards on themselves to maintain flow. This leads to skill and personality development.

Game developers should strive to create games where the player achieves flow while playing [9]. To experience flow while playing a game increases the chance of long term playing. It also gives a greater chance that the user returns to playing if he once experienced flow during a playing session.

3.2.3 Long term playing

The player needs to achieve flow for a game to be attractive to play in the long run, [9]. It is the feeling of being totally focused on the game, and thus forget about time and space, that is sought in order to get the player to continue playing.

To keep the player focused three aspects are required, in addition to achieving flow [9]:

1. Appropriate goals to be achieved by the player;
   It is important that the goals of the game are clear and neither too easy or too difficult. The player should feel goal-oriented and that there is a point to continue playing.

2. Appropriate tools and controls for the player to use;
   For a player to continue playing for a long time, it is important that it is not inconvenient or impractical to play the game. The player must be equipped with the correct tools to help them achieve the game goals.

3. Appropriate feedback to convey information about the current state of the game to the player;
   It is important that the player always knows how far away he is from achieving the game goal to keep his interest in the game.

3.2.4 Freemium as a business model

The huge number of mobile games being launched every day puts a great pressure on the developers to ensure that their game reaches out to people and becomes
profitable. One way to make a game attractive is to work with a known brand to boost sales of the game. If the brand is not yet established on the market, it can work the other way around by the game actually increasing the sales of other products in the brand [10].

The business model of the game has also proved to be of great importance when it comes to making the game attractive on the market. Only 15.5% of users accept mobile games bought with a one-time payment [21]. The remaining 84.5% want games that are free to play, at least initially, but preferably throughout the whole game.

Most users are not averse to paying for exclusive content, boosters or extra lives, as long as it is possible to finish the game in its entirety without any payment [1]. This business model is called Freemium and has the advantage that the price point of the game is very flexible, and is determined altogether by the player’s willingness to pay.

Taking advantage of player impatience and wanting to be the best [10], developers can put deliberate delays in the game, or provide exclusive offers to the player. Player impatience and get-it-now attitude becomes a resource for profitability. It is a difficult balance between fun and profit to get the player to pay during the game, although it would be possible to continue playing for free.

3.3 Game design

Game design refers to the different parts that make up the game and that the player directly come in contact with. It includes gameplay; the design of the game, tutoring; how the player learns and understands the game and feedback; how the player gets response from the game.

3.3.1 Gameplay

Gameplay is the term used to define the way a game is played. It includes the rules of the game as well as the objectives and goals and how to accomplish them. For a player to achieve flow while playing, the gameplay needs to be attractive, [22]. What makes a gameplay attractive is subjective and lies completely in the player’s eyes. However, a clear goal is essential whether it is a level based gameplay or a high score based one. It is also important that this goal is achievable and that is neither too hard nor to simple to achieve it, [8]. As seen in Figure 3.1, if the challenge is too high compared to the ability, the player will become anxious. If, on the other hand, the ability is too high, the player will get bored. The key is to match the challenge of the gameplay with the ability of the player. This will increase the likelihood of the player achieving flow.

Having secondary objectives in a game, such as bonus points, can both have a positive and a negative effect on the gameplay. Secondary objectives that in some way help the player to reach the main goal of the game can have a positive effect on keeping the player’s flow, and through that increase the chance for long term playing [3]. This is because the player is focused on completing levels instead of feeling the need to spend unnecessary time on clearing the secondary objectives.
Secondary objectives that do not support the main goal of the game can actually decrease the time spent playing with up to 50% [4]. This is because the player does not achieve flow due to the fragmented sense of what the main goal really is.

### 3.3.2 Tutoring

In older games like Pac-Man, Tetris and Super Mario, tutoring was seldom done with tutorials. Instead, players learned to play games through experimentation [13]. Today, game complexity and player impatience makes this approach to tutoring difficult. However players seem to learn more from experimentation than from reading a text [5]. It is therefore important to design early levels or chapters of a game, in a way that maximizes a player’s ability to experiment and discover the game mechanics. Small in-game tutorials are justified when the complexity of the gameplay is too high or the cost of failure is too extensive. In these tutorials, repetitive tasks can be useful to get the player to understand and remember the game mechanics [14].

### 3.3.3 Feedback

Feedback from a system is the response the user gets back when he uses the system. It may be visual feedback in the form of graphical changes to the interface, auditory feedback in the form of audio signals or physical feedback in the form of vibrations. In games, giving the player correct and understandable feedback is one of the most important parts to get a player clientele to keep interest in the game and continue playing, [9]. The player needs to know, throughout the game, how far he is from reaching the game’s goal. He also needs feedback on how well he is doing and if he needs to change his way of playing to not fail the game’s goal. Customized feedback when an error is made is therefore important to achieve active participation for the player in the game. As well as customized
feedback when the player takes a step closer to achieving the game’s goal or finishing the game.

3.4 Usability evaluation

To evaluate the usability of a game means to do an evaluation of how easy it is to understand and play the game. It can be likened to doing an usability evaluation of the interface of a complex system. The gameplay of a game can be compared to a system’s purpose and core functions. The tutoring of a game can be compared to the user guide of a system. Feedback from a game is equivalent to feedback from a system.

There are essentially four different approaches to perform a usability evaluation, [18]: Formally with an analysis technique, automatically by a computerized procedure, empirically through experiments with test users, and heuristically by allowing test users to share their opinions on the user interface. The latter two are used in this project. Empirical, described in Section 3.4.1, 3.4.2 and heuristics, described in Section 3.4.3.

3.4.1 System usability scale

The system usability scale (SUS) is a "quick and dirty" survey to assess the global usability of a system based on individual and subjective assessments [7]. The survey, developed in 1996, consists of ten statements and a Likert scale to show how likely or unlikely each statement is (See appendix A). SUS can be used recurring throughout the development process to ensure that the interface is improving and not coming to a standstill, or actually getting worse [6].

The scoring of a SUS survey is calculated as follows; For all claims with an odd item number (i.e., 1, 3, 5, 7, 9), the score contribution is the scale position minus one. For all claims with an even item number (i.e., 2, 4, 6, 8, 10), the score contribution is five minus the scale position. The sum of all score contributions is multiplied by 2.5 and the obtained value is the final SUS score [7].

3.4.2 Post study system usability questionnaire

Post study system usability questionnaire (PSSUQ) is, like SUS, a survey to assess the usability of a system and was developed in the late 1980s, [15]. It contains 19 statements in its original form and a Likert scale from one to seven to show how likely each statement is. Appendix B shows a revised version of a PSSUQ.

Unlike SUS, which only provides a general usability assessment of a system, can PSSUQ also assess the user experience of three subcategories: system quality, information quality and interface quality, [15]. The general PSSUQ score is calculated as the mean of all statements. The subcategories’ scores are calculated by sorting each statement to the category it touches and then calculate each category’s mean.
3.4.3 Heuristic evaluation

To perform a heuristic evaluation is simple, cheap and not very time consuming. Evaluators test an interface, independently, and then share their opinions about what they found good and bad. Giving the evaluators a set of heuristics is a way to help them have usability problems in mind. This might, however, confine the evaluators to only focus on a limited set of issues. Table 3.1 shows a set of heuristics specially designed to evaluate usability in games [19].

| 1. Provide consistent response to the user’s actions |
| 2. Allow users to customize video and audio settings, difficulty and game speed |
| 3. Provide predictable and reasonable behavior for computer controlled units |
| 4. Provide unobstructed views that are appropriate for the user’s current actions |
| 5. Allow users to skip non-playable and frequently repeated content |
| 6. Provide intuitive and customizable input mappings |
| 7. Provide controls that are easy to manage, and that have appropriate levels of sensitivity and responsiveness |
| 8. Provide users with information on game status |
| 9. Provide instructions, training and help |
| 10. Provide visual representations that are easy to interpret and that minimize the need for micromanagement |

Table 3.1: Heuristics for evaluating the usability of a game design

Heuristic evaluations require almost no preparation, apart from finding evaluators to perform the tests. Between three and five evaluators have proved to be enough to find at least 75% of all usability problems [18]. A heuristic evaluation usually does not provide any breakthrough in interface design, but is a perfect way to get a first overview of how well an interface operates from a usability standpoint.
Chapter 4

Method

Chapter Four will describe the methodology used for this thesis. How the pre-study was performed, how the implementation was carried out and how the results were produced and evaluated. It will also describe how the thesis work was managed.

4.1 Project management

Weekly meetings were held with the product owner of the game to discuss progress and make decisions. These meetings were mostly face to face or on Skype. Having the product owner involved throughout the process helped keep the game within the context of what the client ordered and correct mistakes in the early stages.

To keep the project organized and focused on moving in the right direction, the management application Trello was used. Trello uses lists and cards to help keep a good structure of what is being implemented right now, what has already been implemented and what is to be implemented next.

At the beginning of the project all tasks that needed to be implemented were written down on individual cards and placed in a backlog. At each meeting with the product owner, the cards corresponding to most urgent tasks were moved from the backlog to a "To Do" list. When a task had been satisfactorily implemented its card was moved from the "To Do" list to a "Done" list. A snapshot of the Trello management board can be seen in figure 4.1.

![Figure 4.1: Management application Trello](image-url)
4.2 Pre-study

The pre-study study was conducted to find information on what makes mobile games attractive and entertaining. Literature and scientific research papers about player experience and gameplay was read and successful mobile games on the market were analyzed. The pre-study also contained an evaluation of the existing game’s usability and discussions with product owner.

4.2.1 Literature

To get an idea of what creates an entertaining and successful mobile game, academic research was done on what creates a nice player experience and an interesting gameplay. Research on evaluation methods for usability was also carried out. Most academic research was done by reading scientific reports, articles and books that the supervisor of the project recommended. In areas where information was missing, Google Scholar [12] was used to search for scientific reports using keywords.

4.2.2 Competitor analysis

In addition to the academic research, three short analyzes of successful competing mobile games were carried out. The aim was to clarify what made these games profitable, understand their vulnerabilities and find opportunities for differentiation [11] against Entanglement. The three games analyzed were Crossy Road, Candy Crush Saga and Pyramid, all successful games with good tutoring and business models.

4.2.3 Heuristic usability evaluation

A small heuristic evaluation of the existing game’s usability was carried out at the beginning of the project. Five people aged 20-25 were randomly selected in the corridors of the university. They were asked to start the game and play through the tutorial and the first level. No guidance was given unless the test subject got stuck completely.

After the playthrough, the test subjects were asked to give comments on the game. The understanding of how to play the game and the goal of the game were especially asked to be considered.

4.2.4 Product owner’s opinions

To determine in which direction the game would evolve, a meeting was held with the product owner before the implementation began. This was to ensure that progress was made in the direction ordered by the customer. At this meeting the guidelines were laid out for which the game would follow. The game’s level system was discussed as well as the player feedback and how it should be designed.
4.3 Implementation

As the result of previous studies, Entanglement already had a well structured code base that handled all the mechanics of the game. Therefore, some time was dedicated at the beginning of the project to get to know and understand this code base. The implementation phase was then divided into three parts; gameplay, feedback and tutoring. All implementation was done in JavaScript with the framework Phaser.io.

4.3.1 Gameplay

In the first part of the implementation phase, the gameplay of the game was changed. The old gameplay, with beating the highscore as the main goal, was changed to a level based gameplay. To keep the player interested and wanting to continue playing, levels needed to be created that both varied from each other and had a natural progression in difficulty. This was solved by having the number of possible sums increase throughout the levels as well as having the number of attempts to decrease. Variation was also given through different kinds of goals and limits to the players attempts.

To simplify the creation of new levels a JSON file was created that stored all the information on all levels. This JSON file was then loaded and parsed at the game initiation. For each level the following variables was stored in the file;

- The interval in which the sum would be
- The number of attempts the player had to start with
- The goal for the player to achieve to win the level
- The maximum possible score of the level
- A variable saying if the level had a time limit or not

Levels were divided into chunks of ten, which formed an episode. When the player completed a level, the next level was unlocked. When all ten levels in an episode were completed the next episode was unlocked, and so on. To further encourage the player to make a good result in the levels, stars were earned if the player got a high enough score. One, two or three stars were awarded when the player got 20%, 50% or 90% of the maximum score for the level. The progress of the game, as well as the number of stars awarded for each level was stored so that the player easily could continue to play at the level he left off.

4.3.2 Feedback

The second part of the implementations phase focused on simplifying the understanding and reduce misunderstanding for the player while playing the game. Events that were not explained in the game got a helping information pop-up explaining to the player what just happened. For example, when a player made a mistake like mismatched a pair of cards or missed a solution, a pop-up was displayed telling the player what he did wrong and encouraged him to try again.
A winning screen was also added and shown when a player completed a level. This winning screen showed the number of stars the player had achieved on the level and the total number of points collected. The winning screen also provided three buttons for the player to use for moving on to the next level, replaying the current level or returning to the level menu. A screen for loosing a level was also added, this only encouraged the player to try again and provided buttons replaying the current level or returning to the level menu.

The status bar at the top of the view during a game played was also updated. In addition to the sum and the score, which were there before, a score bar as well as the game goal were added. This to help the player keep focus on what his main object was. The number of attempts was added to the right corner, and on those levels with no time limit the clock was removed. To further clarify the different information in the status bar labels were added for the sum, the game goal, the score and the number of attempts left.

Some new graphical elements were created to go with the new game functionality and feedback. These included buttons for playing the next, previous or same level, buttons for levels, collectible stars and tutoring pop-ups. All these elements were created in accordance with the game’s graphical appearance.

### 4.3.3 Tutoring

The tutoring of the game was moved from a pre game tutorial to an actual in game tutoring, were the player learns by doing. The different mechanics and elements of the game are shown to the player by information pop-ups. All features of the game are not shown at once, but the player only gets the information needed to complete the current level. This gives the player a more natural learning curve as he only learns about features when he gets in contact with them.

The tutoring in the first level shows the player how to turn pair of cards. It also explains what the numbers and question marks on the cards means. Last, the tutoring explains how the player pairs two cards of the same value, this is done without the player really needs to consider the possible pairs available. In later levels the player will get more familiar with the mindset to keep to be successful in the game.

### 4.4 Final usability evaluation

After all implementation was done, a final usability evaluation was performed through a PSSUQ. Eight people were asked to play through the game and, afterwards, answer the questionnaire attached as Appendix B. Among the eight test subjects, three had been involved in the heuristic evaluation of the game that was made at the beginning of the project, the other five had never been in contact with the game before.

The results from the questionnaires were added together and the mean of each statement were calculated. A general usability assessment were calculated by adding the results of all statements and calculating the mean. Three subcategories were also calculated by sorting the statements into the correct category and
then calculate each categories mean. The three subcategories and the statements belonging to it can be seen in Table 4.1

<table>
<thead>
<tr>
<th>Subcategories</th>
<th>Statement</th>
</tr>
</thead>
<tbody>
<tr>
<td>System quality</td>
<td>1. Overall, I am satisfied with how easy it is to play this game</td>
</tr>
<tr>
<td></td>
<td>2. It was simple to play this game</td>
</tr>
<tr>
<td></td>
<td>3. I felt comfortable playing this game</td>
</tr>
<tr>
<td></td>
<td>4. It was easy to learn to play this game</td>
</tr>
<tr>
<td></td>
<td>5. The game gave error messages that clearly told me how to fix problems</td>
</tr>
<tr>
<td></td>
<td>6. Whenever I made a mistake using the game, I could recover easily and quickly</td>
</tr>
<tr>
<td>Information quality</td>
<td>7. The information provided with this game was clear</td>
</tr>
<tr>
<td></td>
<td>8. It was easy to find the information I needed</td>
</tr>
<tr>
<td></td>
<td>9. The information provided for the game was easy to understand</td>
</tr>
<tr>
<td></td>
<td>10. The information was effective in helping me complete the tasks and</td>
</tr>
<tr>
<td>Interface quality</td>
<td>11. The interface of this game was pleasant</td>
</tr>
<tr>
<td></td>
<td>12. I liked using the interface of this game</td>
</tr>
<tr>
<td></td>
<td>13. Overall, I am satisfied with this game</td>
</tr>
</tbody>
</table>

Table 4.1: PSSUQ subcategories and the belonging statements
Chapter 5

Results

Chapter Five will present the results of the development during this thesis work on the mobile game Entanglement. It will show the findings of the pre-study, the result of the new gameplay implementation and the result of the end evaluation.

5.1 Pre-study

The pre-study yielded many different possible methods to create an attractive and entertaining mobile game. The results of the academic research, showed in Chapter 3, together with the Competition Analysis, Section 5.1.1, indicated what works on the market and what should be avoided. It was the product owner’s opinions that in the end determined which method should be used.

5.1.1 Competitor analysis

The three games analyzed are shown in Table 5.1, with the approximate number of downloads and the range that in-game purchases lay within. The statistics are gathered from Google Play \(^1\), and thus only concern games played on android devices.

<table>
<thead>
<tr>
<th>Game</th>
<th>Developer</th>
<th>Downloads</th>
<th>In-game purchases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crossy Road</td>
<td>Yodo1 Games</td>
<td>50 - 100 M</td>
<td>7 - 28 SEK</td>
</tr>
<tr>
<td>Candy Crush Saga</td>
<td>King</td>
<td>100 - 500 M</td>
<td>7 - 695 SEK</td>
</tr>
<tr>
<td>Pyramid</td>
<td>King</td>
<td>10 - 50 M</td>
<td>7 - 549 SEK</td>
</tr>
</tbody>
</table>

Table 5.1: Analysis of competing mobile games

Crossy Road

Crossy Road is a simple game with a simple gameplay. The aim of the game is to cross the road as many times as possible. There is no end to the game, only the motivation to beat the high-score and collect coins to use for unlocking new figures. These figures do not change the gameplay, but only provides a greater

\(^1\)Information gathered on September 30, 2015
content to the game, giving the player a feeling that he wants to collect them all, Figure 5.1A.

It is from this feeling of wanting to collect all figures that the game earns money. There are, at the moment, 116 available figures to collect. Four fifths of these are collectible from a prize machine, which the player can use for a sum of 100 coins, or for a cost between seven and ten Swedish krona. The last fifth are special figures only collectible through finishing hidden quests throughout the game.

The brilliance of this concept is that the player needs to play with certain standard figures to unlock certain special figures. Therefore, all the standard figures need to be collected and played with to get all the special figures. The player’s impatience and “get-it-now” attitude [10] is what makes Crossy Roads such a profitable game. Most players do not have the patience to play the game over such a long period it takes to earn 100*97 coins. They prefer to pay the cost between seven and ten Swedish krona and get the figure at once. If the player does not want to pay up, he is also given the choice to watch commercials to earn coins. This also gives revenue to the developer.

The tutoring of the game is minimal. The player is introduced directly into the gameplay as shown in Figure 5.1B. The only guidance is a small animated hand, showing the player to tap the screen. When the players does, he moves forwards and picks up a coin, and so he is introduced to the objective of the game. The second, and last, hint that the player gets is that he can slide to move sideways, Figure 5.1C. After that the player hits traffic and the tutoring is over.

There is no help section in the game to return to either describe the controls nor the purpose of the game. Crossy Roads relies on the player’s curiosity and interest to collect all figures to, on his own, find out how to unlock all special figures. This creates a word of mouth among the players and a buzz about the game, which always is good for the game sales.
Candy Crush Saga

Candy Crush Saga from King is a puzzle game with an almost endless amount of levels, 15 new being added every two weeks. The objective is to move candies to get three, four or five with the same color in a row. Since this is a level based game the player is motivated to try to reach the highest level.

The tutoring in this game is quite extensive, but necessary. The player is introduced to the gameplay by a character that will follow throughout the game, Figure 5.2A. He speaks to the player through speech bubbles and explains what to do next. As the player progresses in the game new boosters and difficulties are also introduced in the same way, Figure 5.2B and 5.2C. All help texts can be skipped, so as to avoid frustration for the veteran player.

![First help](A) ![Boost unlocked](B) ![Obstacles to overcome](C)

**Figure 5.2:** Screenshots from Candy Crush Saga

The game also provides a short help section where the interaction and most common features can be reviewed, shown in full in Figure 5.3. However, the more advanced features of the gameplay are not explained in this section. The functionality of boosters and blockers can not be looked up if the player forgets how they work; they are only explained when they are introduced.

Pyramid

Pyramid is like Candy Crush Saga a level based mobile game from King. It is based on a well-known solitaire in which the goal is to remove all cards from the board by removing cards that are either one higher or one lower than the card dealt. If the player gets stuck, a new card can be dealt from a stockpile of cards. In Pyramid however, the goal varies from level to level. In the beginning the goal is to collect golden cards, which usually are located at the bottom of the cards on the board. In later levels the player needs to remove a number of cards in a row from the board, without using new cards from the stockpile.
Figure 5.3: Help section in Candy Crush Saga

Figure 5.4: Screenshots from Pyramid
The tutoring of the game is, as in Candy Crush Saga, quite extensive and delivered to the player by a character that pops up and tells what to do. The difference of these two games is that in Pyramid the player can not choose to skip the tutoring, see figure 5.4A, nor choose to play any other card that might be possible. This makes the first few levels feel very static. Boosters and difficulties are introduced in the same way as in Candy Crush Saga.

In Pyramid, King has introduced secondary objectives by giving the player the possibility of bonus points. These bonus points are obtained by clicking on scarabs that shows up on the board when a golden card is removed, 5.4B. In Pyramid, King has also chosen to add a time blockade after the first three episodes (i.e. 30 first levels). This means that the player must wait 24 hours to continue playing, see figure 5.4C. The player can choose to ask their friends to unlock the new episode, or simply pay for immediate access.

**King’s business model**

All King’s games are available to play entirely for free. However, extra lives, moves and boosts can be purchased in the games to complete the levels more easily and faster, Figure 5.5A. In some games extra game content can be purchased to individualize the appearance of the game, Figure 5.5B. Kings in game currency are called gold bars and can be purchased in different sized packages, Figure 5.5C. The player is often given a starting package of 100 gold bars at an early level to "finance the adventure". In this way King gives the player the convenience of being able to make purchases without having to waste their own money. When the free gold bars run out, and the player is not advancing as fast as he is used to, he has to consider using real money to buy more gold bars.

![Figure 5.5: In-game purchases in King games](image)
5.1.2 Heuristic usability evaluation

It became clear by the heuristic evaluation that the game was difficult to understand for first time players. The help that was given in the beginning was not clear enough. The test subjects that where given a solution after flipping over only two pairs got no introduction to the aim of the game since the "A solution is possible!"-text was shown instead of the aim introduction. This made it especially hard for these test subjects to understand how to play the game and it took many mismatches, and pure hunches to get an idea of what should be done. The test subjects that were introduced to the aim of the game was also a bit confused in the beginning and made many mismatches before they got a grip of it.

It was also shown by the evaluation that the goal of the game was unclear and that the reward for getting a highscore was too small. The test subjects did not understand what it served to level up, nor what the new icons were good for. The feedback when a game was over was also deemed inadequate. Several test subjects did not understand what was happening when the time of a game ended.

The most important improvements that the test subjects indicated should be done was:

- Show possible solutions in tutoring
- Show score levels
- Better reward system
- Better feedback

5.1.3 Product owner’s opinions

The initial meeting with the product owner resulted in a plan for how the game would develop. The academic research as well as the heuristic evaluation was considered and following decision were made:

- The gameplay would be changed to a level based gameplay
- The tutoring of the game would be rebuilt to an in-game learning tutoring
- The feedback of the game would be reviewed and improved
- The game would keep its aesthetics

5.2 Implementation

The time spent on understanding the existing code base, at the beginning of the project, proved very important. Much of the old functionality could be reused as it was, or only be changed a little to fit the new desired functionality. In total, 6 weeks was spent on implementing the changes to the game. That with all time spent on mocking new features and creation of new graphical elements excluded.
5.2.1 Gameplay

The new level based gameplay resulted in a variety of levels divided into different episodes. All levels and their information was stored in a JSON file, shown in Figure 5.6. This JSON file was loaded and parsed during the startup of the game. At this time the player’s unlocked levels and episodes was collected from local storage as well as the current level and episode.

![JSON file structure for level information](image)

Figure 5.6: JSON file structure for level information

All the levels of the game were divided into episodes, the result of what it looked like can be seen in Figure 5.7A. The new level based gameplay had the player wanting to keep playing the game to always unlock a new level. To further increase the players desire to play the game three collectible stars was added to each level. The higher the player’s score was at the end of the game, the more stars he got, Figure 5.7B.

![Level based gameplay](image)

Figure 5.7: Level based gameplay

5.2.2 Feedback

The feedback that improved the game helped players to understand their mistakes and appreciate their wins. When a mistake was committed a pop-up box appeared telling the player what mistake he committed, as shown in Figure 5.8. When a level was completed a new winning screen was shown to player telling
how well he did. If a player lost a level a new screen was also shown, encouraging the player to try again. Both these screens can be seen in Figure 5.9.

![Mismatched pair](image1.png) ![Solution missed](image2.png)

(A) Mismatched pair  (B) Solution missed

Figure 5.8: Feedback when player made mistake

![Winning feedback](image3.png) ![Loosing feedback](image4.png)

(A) Winning feedback  (B) Loosing feedback

Figure 5.9: Winning and loosing screens

The new status bar, shown at the top of the view during a game played, can be seen in Figure 5.10. This helps the player keep track of the information he needs to manage the different levels. On the left is the current sum displayed and on the right the number of attempts that the player has left. In the middle section, the goal of the level is displayed and how close the player is to achieve it. It also displays the player’s current score with both a figure and in a visual way in the form of a score bar.

![Status bar](image5.png)

The new graphical elements produced for the game can be seen in Figure 5.11. The buttons were used for choosing a specific level and moving to the next or previous level. The star was used as a collectible for all levels and the cloud bubble was used as a pop-up in the tutoring.
5.2.3 Tutoring

The in-game tutoring was developed to not give the player all information at once. But rather just give the information needed for the player to complete the current level. In this way the player is gradually introduced to the game mechanics and can focus on learning one thing at a time.

The first level is introduced by a pop-up, urging the player to click on a card to turn over a pair, Figure 5.12A. And so, the player has learned how to turn cards. When a pair of cards has been turned the player is informed that each pair together form a sum and then he is urged to turn another pair, Figure 5.12B. And so, the player has learned the meaning of the numbers and question marks on the cards. When another pair is turned, the player is reminded that every pair of cards together form the same sum, Figure 5.12C. He is also notified that the sum is shown in the upper left corner.

When the player has turned enough cards to get a solution, a new pop-up is displayed, shown in Figure 5.13A. This pop-up tells the player the aim of the game and how to get points. To further guide the player to make a correct pairing a pointer appears over one of the cards included in the solution, also shown in Figure 5.13A. When this card is selected by the player, the cursor moves to the second card included in the solution, 5.13B. This is how the player is taught how to play the game.

5.3 Final usability evaluation

The result of the questions asked in the PSSUQ is shown in Figure 5.14. A low score means a high veracity of the statement. In the figure, good result are considered as those with a score lower than 2.5, shown in green. Results with scores between 2.5 and 4.0 is considered as moderately good, and are shown in
Chapter 5. Results

26

(A) How to turn over cards

(B) Introduction to the game sum

(C) Reminder of the game sum

Figure 5.12: Introduction to the game mechanics, Part one

(A) Introduction to aim of the game

(B) Learning to select cards

Figure 5.13: Introduction to the game mechanics, Part two
yellow. Red results are those with a score higher than 4.0, these are considered as bad.

The results clearly show the two flaws in the game. Q4, in Figure 5.14, indicates that it was difficult to learn to play the game and Q8 that it was difficult to find the information needed to play the game. What, however, also is shown in the results is that the information given to the player is satisfactorily. The error handling and interface also appears to be satisfactory.

The general usability assessment of the game was moderately good as can be seen in Figure 5.15. It was the system quality that got the highest score out of the subcategories of the PSSUQ. The interface quality was the only subcategory that appears to be satisfactorily.
Chapter 6

Discussion

Chapter Six will discuss the results emerging from this project, the advantages and disadvantages of the chosen method and the work done in a wider context.

6.1 Results

This section discusses the results that became of the thesis.

6.1.1 Pre-study

The results of the pre-study is what laid the foundation for the implementation phase. The academic research together with the competitor analysis shed light on what game features were popular and why they worked in theory. The meeting with the product owner discussed the original game’s flaws that was revealed by the heuristic evaluation. From all this gathered information the decisions on what to change in the game were made and put in the backlog. The backlog is the most important result of the pre-study since this was then used throughout the entire project.

6.1.2 Implementation

The implementation of the new level based gameplay resulted in a more clear objective for the player. Now, the player sees his progress as soon as he opens the game. He sees how many stars is achieved on each level, and how many levels is left on the current episode. Along with the new feedback, in the form of the game starting screen and top bar, the player is well aware of what he is expected to do and how far he is from achieving this goal.

The new graphic elements created and implemented in the game provides an overall sense of wholeness, which is what was pursued. All newly added feedback was based on the same graphical profile as the original game, and many elements are reused to create a recognition factor of the player.

The tutoring created for the game is still not optimal. It works fine on the first level, where the player is given the information he needs to understand the levels goal and how to achieve it. Further, more tutoring in the next levels is needed. All new game mechanics and goals needs to be introduced properly.
6.1.3 Final usability evaluation

The result of the final usability evaluation clearly shows that the player finds it difficult to learn the game and difficult to get the information needed in order to play the game. With this it can be concluded that the game is difficult to understand. To get a more informed picture of what it is the player does not understand a more extensive usability evaluation needs to be done. The evaluation, however, shows that the player is satisfied with the interface of the game and how the error handling is handled.

6.2 Method

This section discusses the method used in the thesis. Advantages and disadvantages are addressed and what could be improved or done differently.

6.2.1 Project management

Management of the thesis was handled fairly well. The weekly scheduled meetings with the product owner made the project retain the right focus and never stand still for long, but always making progress. Using Trello to keep track of the project’s backlog worked very well in conjunction with the weekly meetings. This because it was easy to show what progress had been made from week to week and what should be done next.

Something that could have improved the project management had been to make time estimates for the backlog. With time estimates on each task in the backlog it would have been easier for the product owner to push on the more crucial implementation parts and to discard those task that cost too much in time to make up for it with the result.

6.2.2 Pre-study

The extensive pre-study made decision making regarding which path the implementation should take easier. The competitor analyses revealed what games worked on the market and drawing parallels between their gameplay, feedback and tutoring to the read theory, gave a greater idea of what worked and why. Taking this newfound information to the meeting with the product owner and discuss a solution that would work for Entanglement was not only very rewarding but also fun.

The early heuristic evaluation of the existing game gave a lot of information too. Through that, it became clear which parts of the game worked and could be retained, which parts were not working and had to be removed and which parts needed a little tweaking to become as good as possible.
6.2.3 Implementation

The implementation phase worked well in that the project was guided by the backlog. There was rarely any question marks about what should be done or why, as these questions were answered in the meetings with the product owner. What, however, took longer than expected was to understand the existing code base. This was still a necessary part of the implementation and also very important because as much as possible of the old code should be reused.

To change the gameplay of the game from the highscore based to a level based was one of the biggest changes implemented. Although much of the old code could be reused, quite a lot of time was spent on creating levels and building the structure used to store the data of the levels.

The introduction of new graphic elements and feedback was what went most smoothly during the implementation phase. Although some time was spent on creating new graphic elements and making mock ups of how feedback should be formatted, the work went quickly when the product owner could quickly review the alternatives and tell what she thought looked best.

Designing and implementing the tutoring of the game was what was most time consuming, and unfortunately also the part that suffered most from the lack of time. The tutoring was mocked up in several steps, and reconciliations with the product owner was held regularly. To get an optimal tutoring of the game, however, several user tests had been needed and there was simply no time.

6.2.4 Final usability evaluation

The final evaluation of the game was conducted more of formal reasons than to get an overall picture of how well the game performed from a usability perspective. Of course it gave a little insight to what was good and bad about the game’s usability. To get a complete overall picture a more extensive usability evaluation had needed to be done. To get the game understandable and amusing for children, that target group should have been used as evaluators. Optimal would have been if there were time left after the final evaluation to make changes regarding the comments that arose, and then have a follow-up evaluation to see if it improved the game’s usability.

6.3 The work in a wider context

An ethical concern that is associated with this thesis is that the game is aimed primarily at children. That makes promotion of the game difficult. There is an always ongoing discussion whether it is okay to target advertising directly to children or adolescents. In Sweden, it is in fact forbidden to send direct advertising to adolescents under 16 and to broadcast advertising on television aimed at children under 12 years.

Another ethical aspect is the game’s intended in-game purchases and buying new episodes. Since it is a game meant for children and adolescents, all possible purchases must be carefully designed to not trick children into making purchases
they are not allowed to do. There is no purchases implemented in the game yet, but for upcoming releases this is an ethical aspect that must be taken heed.

The complexity of game should also be considered. Is it really necessary to have this complicated game mechanics? The game might get more easily understood if the mechanics resembled something that the players may have seen before. Then less time could be spent on actually understanding the game, and more on learning math. Which is the purpose of the game.
Chapter 7

Conclusions and future work

Chapter Seven contains the conclusions from the thesis and also a recommendation for future work.

7.1 Conclusions

Each research question stated in Section 1.3 will be addressed below.

1. How can the gameplay of a mobile game be designed to create a pick-up and play as well as a long term playing attitude on the player part.

The level-based gameplay gave the game a natural reward system, which made the game more attractive to the player, as described in Section 3.3.1. The collectible stars introduced on each level also improved the game's reward system. Making the game more attractive indirect increased the chances for a pick-up and play attitude of the player. To know how much impact the change of gameplay has made on the long term playing attitude of the player, more user evaluations have to be done for a longer period of time.

2. How can the tutoring of a mobile game be designed so that it does not interfere with the gameplay and maintains the player's interest in the game.

Changing the original game's tutorial to an in-game tutoring seems to have given positive results to the usability of the game. As shown in Section 5.3, the player found the tutoring information clear and helpful for getting to understand how the game would be played. However, the player still finds the game very complicated and hard to grasp due to the complicated game mechanics.

3. How can the feedback in a mobile game be designed to create a good understanding of happenings.

The feedback and visual impression of the game seems to be satisfactory, according to Section 5.3. This thanks to the several new information pop ups and graphical elements that have been added to the game. The player gets clear feedback when a mistake is made or a level is won. He also gets continuous feedback on how far he is from reaching his goal through the progression bar at the top
of the game. This helps to keep the players interest in the game, as described in Section 3.3.3.

7.2 Future work

Entanglement is far from finished, though it has come a bit further on the way of becoming a game ready for release. For future work the tutoring needs to be expanded. All new game mechanics and goals needs to be explained as they are introduced in the game. More episodes and levels needs to be created, and the progression from easy levels to hard levels needs to be studied. Further, a more extensive usability evaluation needs to be done to discover all ambiguities that exists in the game. Preferably these evaluation should be conducted with children, since they are the target group for the game.
### Appendix A

#### System Usability Scale
©Digital Equipment Corporation, 1986

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
<th>Strongly disagree</th>
<th>Strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>I think that I would like to use this system frequently</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>I found the system unnecessarily complex</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>3</td>
<td>I thought the system was easy to use</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>4</td>
<td>I think that I would need the support of a technical person to be able to use this system</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>5</td>
<td>I found the various functions in this system were well integrated</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>6</td>
<td>I thought there was too much inconsistency in this system</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>7</td>
<td>I would imagine that most people would learn to use this system very quickly</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>8</td>
<td>I found the system very cumbersome to use</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>9</td>
<td>I felt very confident using the system</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>10</td>
<td>I needed to learn a lot of things before I could get going with this system</td>
<td>1</td>
<td>5</td>
</tr>
</tbody>
</table>
# Appendix B

## Post Study System Usability Questionnaire

<table>
<thead>
<tr>
<th></th>
<th>Strongly agree</th>
<th>Strongly disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Overall, I am satisfied with how easy it is to play this game</td>
<td>○ ○ ○ ○ ○ ○ ○</td>
</tr>
<tr>
<td>2</td>
<td>It was simple to play this game</td>
<td>○ ○ ○ ○ ○ ○ ○</td>
</tr>
<tr>
<td>3</td>
<td>I felt comfortable playing this game</td>
<td>○ ○ ○ ○ ○ ○ ○</td>
</tr>
<tr>
<td>4</td>
<td>It was easy to learn to play this game</td>
<td>○ ○ ○ ○ ○ ○ ○</td>
</tr>
<tr>
<td>5</td>
<td>The game gave error messages that clearly told me how to fix problems</td>
<td>○ ○ ○ ○ ○ ○ ○</td>
</tr>
<tr>
<td>6</td>
<td>Whenever I made a mistake using the game, I could recover easily and quickly</td>
<td>○ ○ ○ ○ ○ ○ ○</td>
</tr>
<tr>
<td>7</td>
<td>The information provided with this game was clear</td>
<td>○ ○ ○ ○ ○ ○ ○</td>
</tr>
<tr>
<td>8</td>
<td>It was easy to find the information I needed</td>
<td>○ ○ ○ ○ ○ ○ ○</td>
</tr>
<tr>
<td>9</td>
<td>The information provided for the game was easy to understand</td>
<td>○ ○ ○ ○ ○ ○ ○</td>
</tr>
<tr>
<td>10</td>
<td>The information was effective in helping me complete the tasks and scenarios</td>
<td>○ ○ ○ ○ ○ ○ ○</td>
</tr>
<tr>
<td>11</td>
<td>The interface of this game was pleasant</td>
<td>○ ○ ○ ○ ○ ○ ○</td>
</tr>
<tr>
<td>12</td>
<td>I liked using the interface of this game</td>
<td>○ ○ ○ ○ ○ ○ ○</td>
</tr>
<tr>
<td>13</td>
<td>Overall, I am satisfied with this game</td>
<td>○ ○ ○ ○ ○ ○ ○</td>
</tr>
</tbody>
</table>
Bibliography