Chapter Three

Methodology

3.1 Description Of The Game

"Recipe Fractions" is an educational computer game which has multiple levels, each of which presents the user with different types of mathematical questions based on the topic of fractions. The types of different questions presented were created by grade 4 teachers, based on what they teach in class using the Maltese syllabus. The game makes use of timers and rewards the players with points, which are established gamification techniques. These were used purposely in order to make the game more interesting for the users, and to create a competitive environment between them.

The game takes place in a restaurant where customers spawn in one after another until the restaurant is full. Once a customer has found an unoccupied table and has sat at the chair, the waitress will bring over the menu for the customer to place an order. After the customer has placed an order, the waitress will walk over to the chef to hand over the order. If the chef correctly cooks the pizza to the customers chosen size then the customer will eat it, while the user is prompted with a bonus question that could earn him/her points. Otherwise if the user answered the initial question incorrectly then the customer will leave the restaurant and no points are awarded. As customers leave the restaurant, whether be it because they finished eating their pizza, or if they left because the chef cooked their order incorrectly,

then more customers will spawn in and take up the now free seats in the restaurant. There will be a total of 6 customers that spawn in.

In the level described above, there are two types of questions on fractions that take place. The first of which is triggered when the chef is handed the customers order, and the second is a bonus question that is triggered only if the first question is answered correctly. For the first question, the customer orders either a fraction of a pizza, or one whole pizza. When the order is presented to the chef, the user is prompted to click on a button that correctly matches the fraction of the pizza that the customer ordered. If the answer given by the player is correct, the second question is triggered. This second question is a bonus question that is more difficult than the previous question and could award the user with more points if it is answered correctly.

Once all 6 customers have left the restaurant, then level 2 will begin. In this level, a delivery man enters the restaurant and walks up to the chef. The delivery man points out that after having cooked so many pizzas, the restaurant must be running out of ingredients. Another fractions question is given to the player for each ingredient the delivery man points out is running low. These questions are more difficult than those in the first level. More points are awarded for each correct answer given by the player. The chef will buy ingredients from the delivery man to replenish his stock, and the game will come to an end.

In the end screen the user is thanked for playing the game, and the stats of the users latest run are displayed on screen. The stats consist of the points the user acquired from answering questions correctly, and the total time it took the user to finish the game.

3.2 User Interaction

Upon start up of the application, the user is shown a simple GUI where the options to either start or quit the game are presented.

Since the game is intended for primary school children, it was designed with a very simple

user interface. The users only task is to click on the on screen buttons that will appear during the different parts of the game. The questions in the game all have the same format, where the question is presented to the user with four possible answers, one of which is correct.

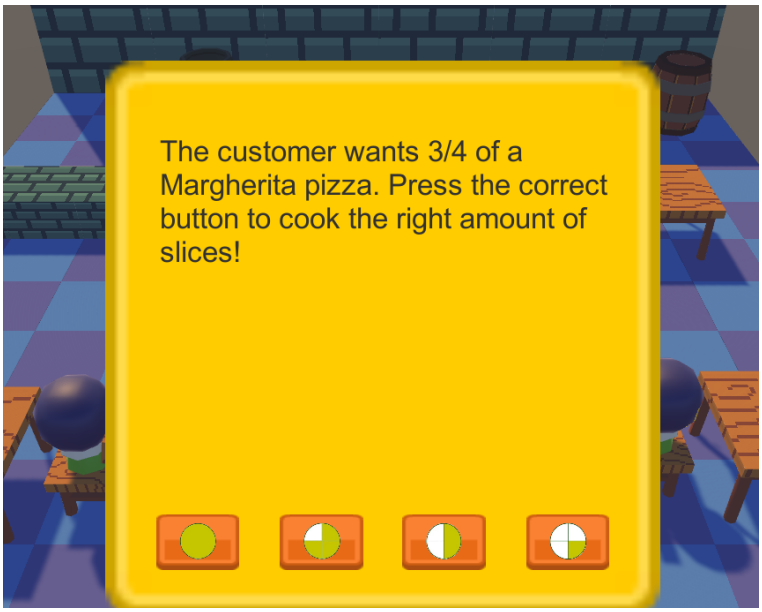

Figure 3.1 Question presented to the user

During the first level, the user will interact with the game by selecting what type of pizza the customer wants to order. Once the waitress takes the order to the chef, the user now is presented with their first question. If the player answers this question correctly, a second bonus question appears which is a bit harder. This exercise is repeated for each individual customer that enters the restaurant.

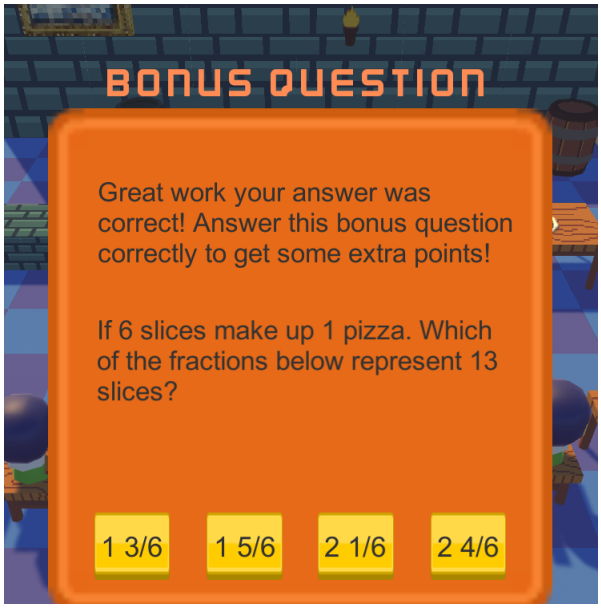

Figure 3.2 Bonus Question

Once all six customers have left the restaurant, level 2 will begin. As stated above level 2 consists of a delivery man walking up to the chef to discuss the restaurants diminishing stock of ingredients. Here the user is presented with three more questions, all of which are harder that the questions in the previous level.

Figure 3.3 Level 2 Question

Players have two goals to aim for. The first being to answer questions correctly, and the second being to answer the questions in the fastest time possible. Both of these parameters are shown on screen constantly.

The questions in this game were made with the use of maths books that are used for the Maltese maths syllabus, and input given by grade 4 teachers. The questions are also randomly generated so that the game can be played multiple times without students being able to memorize any patterns in the answers.

3.3 Participants

The game was tested out in a total of 5 sessions (each session being the duration of a whole lesson - 45 minutes). The first four sessions were carried out in 2019 and the fifth was carried out in 2020.

The sessions done in 2019 consisted of one class of grade 4 students and one class of grade 5 students. Each class was split up into 2 groups, where one group would go to the computer labs to play the game, while the second half would stay in class having a normal fractions lesson. These groups alternated for the following maths lesson, where the group that previously stayed in class went to play the game and the group that previously played the game stayed in class for a fractions lesson. Each boy that played the game had his time taken and score achieved recorded.

The session done in 2020 was done differently since the Covid-19 situation caused all schools to close and lessons be done remotely through video call. The session involved a total of 4 boys. Each boy played the game individually through a teacher running the game remotely shared her screen with one boy at a time. The boys played the game this way and had their score and time taken recorded.

3.4 Methodology Used

The methodology used for this project focuses on both the quantitative and qualitative methods. The quantitative method was used because by using the prototype game created for this project, it was possible to quantify and better understand the difficulties the children have with the fractions topic. What made it possible to quantify their difficulties is the fact that the prototype displays the individual child's score and time at the end of a play through. These scores were documented and displayed in line graphs. The qualitative elements come in when after all the sessions were concluded, the boys who took part and the teacher in charge were all asked a few questions about the experience. These questions were asked with the purpose of understanding how the sessions went, what feedback the people involved have and to see what improvements can be done to the game.

In order to analyse the prototype created, a total of 64 participants played the game. From these students, 34 were grade 4 students who had completed most of the fractions topic for that year. From the grade 4 students, 30 had their session in 2019 and the remaining 4 had their session in 2020. The other 30 students were from grade 5, who were more familiar with fractions as more topics in the grade 5 syllabus make use of fractions. The reasoning behind why these two groups were picked was to contrast the results between students who have so far only studied fractions as an individual topic, between children who have used fractions as a tool in other topics therefor giving them a better grasp on the concept of fractions.

The sessions that took place in 2019 were organized to have a teacher monitor the sessions While the children played. Photos were taken of the sessions and the teacher in charge was asked to observe any competitive behaviours by the children. Competitiveness between children was sought after in this study as it is a product of gamification that could be used as motivation to compel children to keep playing the game.

The sessions in 2020 were organized by the same teacher that was in charge of the sessions in the previous year. Due to the Covid-19 situation all schools were shut down and lessons

were being carried out through video calls. The teacher set up the game on her computer and had 4 children play the game one at a time.

At the end of each child's play through, their score and time taken was recorded by the teacher in charge. The students were given the option of playing the game again once they finished it, those who agreed had their scores updated. The students were collectively asked whether they thought the game was difficult or not. The grade 4 students thought the game was difficult while the grade 5s who were more experienced on the topic thought it was not so hard. All the data was written down on a paper by the teacher who supervised all the sessions.