Analysing Player Motivation when using Dynamic Difficulty Adjustment in Games

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Authorship Statement

This dissertation is based on the results of research carried out by myself, is my own composition, and has not been previously presented for any other certified or uncertified qualification.

The research was carried out under the supervision of Dr Owen Sacco.

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Copyright Statement

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Contents

List of Figures

Abstract

For this study, research was done about Dynamic Difficulty Adjustment (DDA) in video games on how it is implemented and how it works. This research was done before the planning of the prototype took place. After researching multiple papers about DDA, research about players motivation in video games was also done. Once all the research was done, the information was gathered to plan the implementation of the DDA in the prototype to have the best adjustment possible while also keeping in mind the improvement of the player's motivation.

For the prototype, a group of people were asked about the testing of the DDA implementation. This was done to make sure that the adjustment was done correctly for different skill levels. Once the prototype was finished, twenty participants took part to help with the data collection for this study. These participants were not involved in the testing phase to remove any biased results. The prototype consisted of different levels so the DDA algorithm would have enough time to determine the correct difficulty for the player.

Once the participants finished playing the prototype, they had to answer some question in a questionnaire while also providing the results from the prototype. This was done so the data collected was as accurate as possible in the form of a mixed-method approach since the data is gathered in two different ways. The results obtained from the data collection proves that the participants were indeed motivated to play the prototype with the help of the implementation of DDA. The participants mentioned that the adjustment was done to be the same as their skill level which could be one of the reasons why DDA did affect their motivation. Some participants mentioned that DDA was not done correctly, but as mentioned this could have been because they had fallen off the map numerous times. However, future improvements to the algorithm can arrange the small issues that were shown by the participants.

Chapter 1

Introduction

1.1 Dynamic Difficulty Adjustment

Dynamic Difficulty Adjustment (DDA) is used by game developers to automatically adjust the difficulty of the game for the player. To implement this into a game, an algorithm is built by developers depending on the game. The algorithm will have the potential to change the games behaviour, features and scenarios in real-time. The reasoning behind this process is to keep the players interested while they are playing the game from when they start to when they end their gaming session. For this algorithm to be successfully implemented, data will be gathered from the game to determine how to adjust the difficulty of the game. In Chapter 2, this information is explained in-depth with other topics about the study. This was done by the research conducted to aid in this dissertation.

A Player's motivation in video games is very important, this is because if the players are not motivated to play the game they would stop playing. Motivation can be achieved in many ways, and it is important for game developers to keep in mind different players are satisfied in different ways. An overview of different ways to improve players motivation will also be researched in Chapter 2.

1.2 Aims and Objectives

The objective of this research study will see if dynamic difficulty adjustment (DDA) will be able to help improve players motivation in video games. The method for this will be using a prototype which the participants will play with the implementation of DDA, and after they would be asked to answer some questions in a form of a questionnaire. Once everything will be done by the participants, data will be collected from both the questionnaire, and the prototype thus meaning a mixed-method approach will be used for this research. When all the results are available, they will be analysed and compared with each other to make sure that the results discussed will be as accurate as possible.

The research will aim to answer the following questions:

- How should a game adjust its difficulty for the player without suddenly having a big change in the gameplay?

- Can a proper implementation of Dynamic Game Difficulty improve the player's motivations in video games?

- When should the game's difficulty be adjusted in the game to match the player's skill?

1.3 Research Structure

This dissertation will be split up into different chapters to help label the research done. Firstly, the first Chapter will be this one, the Introduction. In this section, a brief overview of the research will be provided for the readers. Alongside the overview of the research paper, the reader will also be provided with a set of research questions which will eventually be answered throughout the study and highlighted at the end of the research.

Following the Introduction, the second Chapter will be the Literature Review. In this section, Dynamic Difficulty Adjustment will be mentioned and researched. Alongside the research about how DDA is implemented and when it is adjusted in-game, research about current video games that use DDA will be researched to see if there are any advantages or disadvantages to their implementation. Research about players motivation in video games will also be done to understand this part of the study as much as possible.

The third chapter will be the Methodology. In this chapter, the implementation of the prototype, how it was done, and what was used will be discussed. Due to this, the reader will be able to read about the programs used to construct the prototype, how the implementation was done, and all the components that were used.

In the fourth chapter, the reader will find the information about the data that was collected and how the data was collected in more detail. Once the data collected will be analysed, it will also be discussed and compared to each other to have the data as accurate as possible. This Chapter is very crucial to the research as it will help prove the research questions that were mentioned in the chapter previously if they are true or not.

The following and final chapter, the Conclusion, will include the answers to the research questions mentioned and followed by the contributions of knowledge.

Chapter 2

Literature Review

2.1 Dynamic Difficulty Adjustment.

Dynamic Difficulty Adjustment (DDA) allows game developers to implement an algorithm in their game that will automatically adjust the difficulty of the game for the players. The algorithm will be able to change the behaviour, the games features, and scenarios in real-time depending on the player's skill. DDA's purpose is to keep the player interested in the game from the start to finish. DDA is used in both Single player games and Multiplayer games but the algorithm works differently for both (Tan et al. 2011a). In single-player games, DDA is used once the player reaches a new checkpoint, finishes a quest and so on. This is done so once the player is in the middle of an objective or similar the difficulty of the game doesn't change immediately which could cause the player to be confused or also frustrated. On the other hand, DDA in multiplayer is a bit more complex since the algorithm will need to evaluate the same amount of data but of a lot of players which then it will need to compare all the player's data so they will be matched with others of the same skill gap. (Tan et al. 2011a) This is mostly used in competitive games such as CS:GO, VALORANT, Rainbow Six Siege, and many more. They have their playlist of competitive mode which will gather the player's performance and after each game, the player's points will be adjusted depending

on the performance. Depending on the player's skill point, they will be placed in their respective skill gap so the games will be of similar game skills (Ebrahimi & Akbarzadeh-T 2014).

2.1.1 Dynamic Difficulty Adjustment against difficulty modes and traditional games.

Difficulty modes in games are not the correct approach for the player to have the correct difficulty to play against the rest of the game. This is because the player won't know how the game play will be thus not knowing what to choose for the difficulty. It was proposed that the players will have a tutorial level at Medium difficulty, and once the player will be done with the tutorial they player will have a better understanding of what difficulty they want to play on since they tried the game on the Medium difficulty (Gamasutra 2008). On contrary, it is mentioned that DDA doesn't have any problems like that since it will find the correct difficulty for the player automatically by adjusting the difficulty for every player between boredom and anxiety (Zohaib 2018). Further on, Adams goes against that statement since he mentions that DDA is generally hated since it doesn't have a stable difficulty (Gamasutra 2008). Later on, it is mentioned that DDA doesn't in fact always solve the difficulty problems in games. With this argument, it states that DDA can in fact work for small games such as an indie game but won't work for bigger games. This is because massive games will have much more factors and data to consider, that the implementation for the DDA algorithm won't work (Gamedev 2018). In traditional (older) games there wasn't a difficulty mode or DDA in games. The difficulty in such games was changed throughout the game. This means the more the player progresses in the game, the harder the difficulty gets. This would lead to a negative experience for some players since they would have to face a predetermined learning curve for the game, which could be difficult for some players to beat (Gamedev 2018).

2.1.2 Data used for Dynamic Difficulty Adjustment.

For DDA to change the difficulty of the game for the player, there will be the need to collect data of the player's gameplay. The data that is collected isn't always the same since games are different from one another. Data that is collected while the player is playing is the score of the player and win percentage which was used in the research by (Tan et al. 2011a). In a different research, the data collected to use in DDA was the deaths, health restored, and player jumps (Buckley et al. 2013). As mentioned earlier, the data that will be collected will differ from one game to another. If the game is an FPS game, the accuracy of the player will need to be collected which will be used alongside the deaths of the player with the kills in the same life. In games like platformers, data like score, health and win percentage will be more suitable for those type of game. This is because most of these games don't have enemy AI's against them, so the accuracy won't affect the outcome of DDA.

2.1.3 Game difficulty adjustment with DDA.

For DDA to adjust the difficulty of the game there will need to be set parameters that will be changed for the AI in the game. These parameters will determine the change in difficulty for the player. Some parameters that can be used in most of the games are the aggressiveness of the AI. This means the radius that the AI will have to go for the player, being a bigger radius, the AI will go for the player more frequently. Another parameter that is commonly used in fighting games is AI health. This can be used after determining if the player is dying too quick or by the time the player will be able to kill the AI it will be too late for the player since the AI will have too much health. A parameter that can go hand in hand with the health parameter is the weapons used or the damage done by the AI. If the player is dying to quickly the damage done by the AI should be lowered to give the player a better chance and vice versa if the player cannot kill the AI in time

the health should be lowered (Ebrahimi & Akbarzadeh-T 2014). These changes in the parameters need to be done in a way that won't be obtrusively for the player. This will result in the players staying immersed in the game and won't have any bad motivation towards the game.

2.1.4   Games that use Dynamic Difficulty Adjustment.

A big gaming development company that owns the Elder Scroll title Bethesda have used Dynamic Difficulty Adjustment in different approaches. In Elder Scrolls: Oblivion approach while using DDA made sure that the players completed a certain quest before moving on to a new level. This was implemented because they didn't want players to enter certain levels while they won't have the required item to beat such level. Since the game uses DDA thus changing the enemy mobs certain mobs wouldn't be easily locatable by the player, thus resulting in having a low chance of completing some quests. In the following game that was released in the same title, being Elder Scroll: Skyrim Bethesda still used DDA within the game but with a different approach using the mistakes made in the previous game Oblivion. In Skyrim, the developers have implemented three different types of areas that the player will go against. One type of area is that the game would constantly adjust the difficulty to match the player's skills with DDA, an area-type that will have determined low-level difficulty enemies. This was used so the player would get a challenge at the beginning of the game and then later would feel even more powerful. The final area type is the contrary of the previous one, by having hard difficulty enemies to show the player how powerful some loot is a thus making the player complete the quest to get them to use later on in the game (Svg 2018).

Another developer studio also used DDA in their game to help players that got frustrated in their game. Naughty Dog which owns the title for the famous Crash Bandicoot games have started implementing DDA in their games from Crash Bandicoot 2: Cortex Strikes Back. After they saw the frustrations some play-

ers were having with their game, they decided to use DDA. The adjustments that were done in the game was by adding more checkpoints for the player, spawning better powerups, or slowed down the movement speed of the obstacles that chased Crash (the player's character) throughout the game. These changes were made if a player constantly failed at the same part over and over. With these adjustments made, everyone managed to complete the game and have fun. This resulted in Crash Bandicoot being a very popular game and Naughty Dog adjusting DDA for their next game made people love the game. Everyone loved playing Crash Bandicoot after this because everyone ended up playing a different game since the difficulty adjusted for everyone, so it didn't matter if the player was bad or good as they both managed to enjoy and finish the game (Svg 2018).

2.1.5 Challenges when implementing Dynamic Difficulty Adjustment.

Gaming has been getting new players every year, which means that there will be a lot of beginners in the game. Developers face the issues to keep the beginners away from those players that have a lot of experience, so the newer players don't feel frustrated dying without having a chance to fight back. Activision, who owns the title for Call of Duty (COD) have multiple studios under them. These studios are split to make different COD game throughout the game. Developer studio Sledgehammer Games implemented Dynamic Game Difficulty in Call of Duty: Advanced Warfare in the multiplayer mode. Although the intention behind this was so players of similar skill would face each other, the implementation for this was easily abused by the players. An article by Tom Phillips, explains that players used to kill themselves over and over in-game to get a lower Kill Death Ratio (KD). The reason behind it was since the adjustment was based on the KD of each player, the players doing this over and over in a couple of games would result in them facing lower-skilled players. Further on, the article quotes what the Co-founder and boss in that time Michael Condrey said about the reverse boosting happening in

every game. He mentions that this was ruining the player's experience since they had a teammate(s) doing this, therefore resulting in a disadvantage since they will be missing a teammate which would also lead to frustration in an objective game mode (Eurogamer 2015).

2.2   Player motivation while using Dynamic Difficulty Adjustment.

When a game is using a DDA algorithm it can either be a good implementation for the player or a bad one. This is because if the difficulty of the game adjusted by DDA is not like the player's skill gap, they will be frustrated playing the game if the difficulty of the game suddenly adjusted is hard for the player. On contrary, if the game difficulty will be too easy for the players, they will feel disappointed playing as there won't be any challenge for them (Ebrahimi & Akbarzadeh-T 2014). Therefore, if the players will be frustrated or disappointed at the game their motivation to keep on playing will be low, thus resulting in the player quitting playing the game and possibly post a bad review on the game. If the implementation of DDA is done correctly it will guarantee that the players are interested in the game from the start to the end. Due to this the motivation of the player to play the game will be high (Ebrahimi & Akbarzadeh-T 2014).

In a different research, it also mentions that having the game difficulty to easy or too hard for the player will not result in a good experience for such players (Tan et al. 2011b). It also mentions that there is a different type of players in the world which makes it harder for developers to have the appropriate difficulty adjustment throughout the game. The game can be considered satisfying or entertaining when a game is difficult to beat and they manage to win. Unfortunately, this isn't how every player feels, it is mostly the advanced players that are used to such mechanics and have a lot of hours playing games thus have experience. This reasoning may be

the opposite for casual or beginning players. A game is enjoyable for such players if the game is challenging thus not being easy but still having a good chance at beating it. In research that was done, it was found that players prefer having an opponent (AI) which will adapt to their skills. Further on it mentions that for multiplayer games in a competitive mode it should have an evenly matched opponent as mentioned earlier (Tan et al. 2011*b*).

2.2.1 Ways a game can improve players motivation.

The design of the game will be able to satisfy a variety of players (Tan et al. 2011*a*). With the help of the game design different type of players can play in the way they like but still will be able to complete the game and collect and complete any challenges. It is also mentioned that having the game adjusting to the player's proficiency will be able to customize and entertain the players to their liking. A player's motivation in video games relies on game features. Some of these features are the attractiveness of the game, speed of learning the game, and game knowledge (Sánchez et al. 2009). Having attractive game assets will help the player experience. This is because a lot of people like to play games to have fun and not having matching assets, assets that don't go along with the game and more would lower the motivation of the player without them being able to avoid it. Alongside the attractiveness, having a complex game system that will take a long time for the player to learn might also reduce the motivation to keep on playing since a lot of people play games for fun, although some people like to have challenges in games.

2.2.2 Game rewards to improve motivation.

In research done by (Phillips et al. 2018) they found that having a greater variety of rewards when a player completes a quest, or a challenge would impact the player's interest and enjoyment in the game. It was also mentioned that there weren't any specific rewards that would impact the player greater than others.

Chapter 3

Methodology

3.1   Introduction

In the research that was mentioned in the literature review, the prototype for it used different programs for the implementation. The programs used were Unity, Visual Studio and Photoshop. These programs all had different uses which helped with the creation of the prototype. In the prototype, the user will have a total of three levels and a tutorial at the start on how to play the game. While the user is playing the game Dynamic Difficulty Adjustment (DDA) will alter the difficulty of the game to match the skill of the player and keep the player motivated to continue playing the game.

3.2   Prototype

3.2.1   The benefits of a Prototype

With the help of a prototype in research, it will aid in gathering data in relation to the research being conducted. Apart from data from the game itself, the prototype will also help with feedback by the participants about the prototype to see if it is proving the hypothesis or not. The prototype that was done to help analyse the

research was well designed and was complexed where it only needed minor touches to be a final product. With the help of this design on the prototype, it allowed me to gather more accurate data from the participants since no issues were affecting them while playing the game.

3.2.2 Prototype outline

For my prototype, a platformer genre was used to help prove my hypothesis and research statement. The participant will have to move throughout the map to collect gems and a key that will be used to advance for the following level. While the player is progressing throughout the level, they faced two different types of enemies. The first enemy only walked towards the player and damaged them on contact and the other enemy shoots at the player once they were in range. While the participant manoeuvre throughout the map they had to watch out for their movement as they could fall down the map and die in the liquids depending on the level. If the player ended up dying, they respawned on the last checkpoint they took so they continue playing the game and not lose the game because of one mistake.

3.2.3 Dynamic Difficulty Adjustment

The implementation of Dynamic Difficulty Adjustment was done to adjust the difficulty of the enemies depending on the player's health and player kills. To adjust the difficulty of the game it was done once the participant went from one level to another. This was done so the difficulty wasn't adjusted mid-level which could affect the participants such as feeling frustrated and losing motivation to continue playing the game. The timing of the readjusting the difficulty is very important in dynamic difficulty games as it could lead to a lot of problems and would easily make the user feel cheated if the difficulty is suddenly changed out of nowhere. Adjustments done to the enemy was the movement speed, damage done

and the fire rate at which they shoot towards the player. These values were chosen after a lot of testing with five testers to determine what the best values were to help with the adjustment of the difficulty of the specific game genre being used. The reason behind them was that when a newer player that had a low reaction time wasn't managing to kill the enemies in time before dying. Therefore, the adjustment in the fire rate of the enemies was done and tested the difficulty again with the participants. In the initial test, there was already significant improvement but there were still some issues with it being a bit too fast for the newer players and too slow for the experienced players at the proposed difficulty. After some more adjustments the values were arranged which were giving a chance for different players to complete the game but at the same time giving them a challenge, so they didn't feel bored while playing the prototype. While doing changes in the fire rate, it was shown that the fire rate alone won't be enough to adjust the difficulty for the lower-skilled players. At first, depending on the performance of the player more health pickups were available to be used but it was still being a bit difficult for them. After more testing, the enemies damage variable was adjusted and tested for all the testers that were participating in the testing phase. The change of the damage done by the enemy was that at the low-skilled section the damage towards the player was half a heart and if the difficulty was higher than that the damage was increased to a full heart per hit by the enemy. This change helped players of different skill level in different ways, as none experienced players had a higher chance of beating the game and experienced players could still beat the game but it gave them a challenge for it to be more entertaining at the same time. Lastly, the final adjustment done in the difficulty of the enemy was the speed at which they patrol. This was done so the enemy type that only walked towards the player would give the higher skilled players a challenge as when it was a static value for all the testers it couldn't have been a good value for all of them. Therefore, depending on the performance of the player the adjustment in the enemy speed was also adjusted from level to level. At the end of the testing, the changes of values were enemy

speed, enemy damage, and enemy fire rate as mentioned earlier.

3.2.4   Motivation in-game

Motivation in video games can be achieved in a lot of ways if done correctly. In my research, I am analysing if players motivation can be increased with the help of dynamic difficulty adjustment, but it wasn't the only implementation done to improve it in the prototype. The game design done throughout the prototype was planned out and different styles were tested to find the best way to lead the player to the next level. Game design is one of the most important things since it will lead the player on where to go next, what the player has to face to go to the next part of the level and help the player explore the map. This was also helped with the testers motivation to play the game since it wasn't a quick game to finish but they had to go from certain parts of the map to advance to the following level. The players could either explore all of the maps and pick up items along the way and see the score at the end of the game or they could decide not to pick up any collectibles and finish the game as fast as they can. If the players did not pick up any items in the levels that could lead to the player not being motivated to play the game as they wanted to finish it very quickly. It could also be that the player wanted to speed run the levels to achieve a personal record of how long it would take them to complete the game. This wouldn't be the ideal case for the prototype since there isn't any objective to finish as fast as you can neither having a timer built into the game. To help the player explore the map, apart from the collectibles throughout the map they also had to pick up keys to be used to advanced to the following level. This was done so the players had to look around the map while viewing different areas. As mentioned earlier players could pick up gems throughout the map, even though they were optional and didn't have any effect on the gameplay most of the testers decided to explore each level for them to try and find them all as a challenge for themselves.

3.2.5   Game UI

In video games, the UI for the user is very important as it needs to show as much information as possible while being clean and simple. In the first part of the game which was the tutorial, the player will trigger different parts around the map which will show some text explaining the controls which the player can immediately try. Some of the examples of the tutorials show where the movement, how to double jump and the importance of the keys. Tutorials in games are usually better than having the user go in the settings to see the interactions they can do as they could immediately try what is being shown. The other important UI shown in the game was the player health, the gems collected at each level and if the key was collected for that level. This information was strategically placed in a position where they are normally placed in other game because experienced players will look at that position immediately for the information they need.

3.3   Software used

The creation of the prototype required the use of three different programs. First, unity was the first software used to start the prototype. The Unity version used was 2020.1.5f1 which was used with the development as it was already installed and tested without running into issues. The level design, UI, and effects were done using Unity. The UI was carefully thought out to be as simplistic as possible but also show all the information needed for the player. Two packages were installed to help with the completion of the prototype. First, the '2D Tilemap Editor' was used to create the design of the levels and on what the player will use to stand on. This package was specifically used since its main purpose is for platformers and since the prototype was planned as 2D the 2D version of this package was used. The second package used was 'Cinemachine' which helped the player feel immersed since it leads the player the way they are moving. If the player is moving to the right side of the map the camera will lean towards the right so the player can see

further ahead to have a better vision of what is coming up. Secondly, Visual Studio 2019 was used to create the scripts to complete the prototype. The scripts that were created consisted of the player movement, player shooting, enemy movement, enemy shooting and patrol, health system and the game data which was used to adjust the values for DDA. Thirdly, photoshop was used to adjust some of the free assets that were used for the game. Adjustments done were colour changes to some assets and resizing of the assets used as well.

3.4   Assets used

For the prototype free to use assets were used to complete it. The assets used were all from the website named 'Kenney' which provides assets for all type of game genres such as platformers which was used for the prototype, space shooters and much more. The license to use these assets are free therefore no payment was required. The specific assets packs that were downloaded and used for the prototype were the 'Platformer Art Deluxe' and 'Abstract Platformer'. These assets packs used had all the required assets need for the prototype such as the animation that was created for both the player and the enemy, pickups used, game design and the background images used for each level. With the help of these assets, it helped the user's to stay immersed due to the art style and assets used, as they were consistent throughout the prototype.

3.5   Data Collection

This research paper has gathered data utilising the mixed-method approach, therefore, meaning that both quantitative and qualitative data were gathered. The reasoning behind choosing this method was that both data from the prototype and the feedback given from the participant is important. This is because it will be certain that the findings found from testing the prototype are based on the participant's

experience. All the participants that tested the prototype weren't required to sign a consent form since all the data that was collected is anonymous. Before they started playing the game, they were informed what the research was about to have a better understanding of the topic and the purpose for them participating in the data collection for this research question. A qualitative questionnaire was given to each participant before playing the prototype to see if they have any experience playing video games or not and if they have a general idea about the sector. Once they completed playing the prototype the participants were required to return to the questionnaire provided previously to answer some questions directly about the prototype. This was done so more data would be gathered that could help prove the hypothesis or not with direct feedback from the participants. Additionally, as mentioned earlier quantitative data was collected through the results of the user while playing the game. These results were asked to be put in the final question by the participant so all the data would be gathered in one place. The results that were collected in-game will be used to compare them with the feedback given by the user in the qualitative questioner to see that the data matches with each other. Data that was collected in a quantitative way in-game was to determine whether the player was motivated to play the game or not, and also the score of the player to be used alongside the other data in the findings.

Chapter 4

Findings and Discussion

4.1 Introduction

As mentioned previously, for the data collection for this study a mixed-method approach was used. This was used so data will be gathered from in-game variables at the end of the prototype and data directly from the participants. The reasoning behind collecting data from the participants was since not a lot of studies were available about player motivation with dynamic difficulty, therefore the data collected and analysed needed to be as accurate as possible. To add to that, having data collected from different means can be compared with each other to help strengthen the results as much as possible. The participants downloaded a .zip file which included the prototype and a link to a questionnaire. Since the prototype had a tutorial level, instruction was not needed for the participants on how to play the game but a small note as an idea of how the prototype is designed was given. Moreover, the questionnaire contained questions to gather general knowledge about each participant, such as if they have previous experience in playing games and questions regarding the prototype such as if the prototype affected their motivation with the implementation of dynamic difficulty adjustment. A total of twenty participants helped with the data collection of this study, which will show how they answered the questions provided and the variables of the prototype. Af-

19

ter that, the data will be compared with each other, and the data will be analysed with the literature review.

4.2 Questionnaire

4.2.1 Participants knowledge

Below shows that 70% of the participants that participated were in the age group of 18-24, 20% in the 25-34 group and the last 10% were in the 45-54 group. This shows that the majority is of a small age group. The reasoning behind the majority is because most of the participants that were presented to be a participant were people of similar age as me.
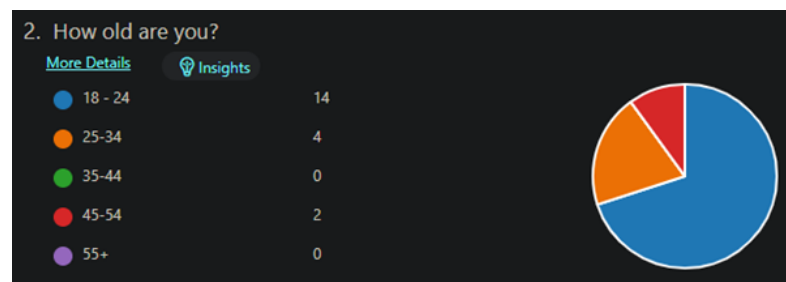

Figure 4.1: Results showcasing the participants age groups.

Moreover, 80% of the participants noted that they were Man and the other 20% were all marked as Woman. The big difference between the answers could be that more Man plays video games than Woman from the people that were asked to be participants.
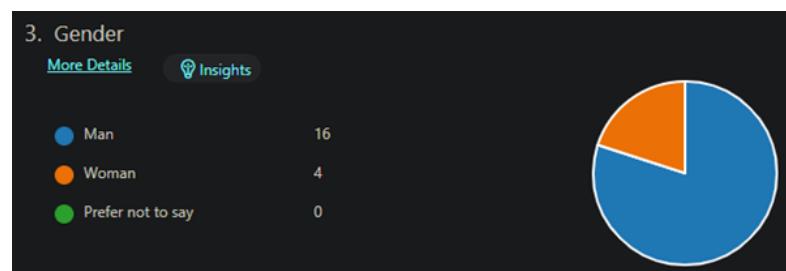
Figure 4.2: Results showcasing the participants gender.

4.2.2 Participants game knowledge

The following questions were about the participant's involvement with video games in general. Firstly, the first question was if they like games. The majority with a total of 85% mentioned that they do like playing video games while the remaining 15% listed that they do not like playing video games. Since most of the approached participants are younger it could lead to the reasoning that this could have impacted the results for this question.

Figure 4.3: Results showcasing if the participants like video games.

Secondly, they were asked how often they play games. The majority answered that they play monthly with a total of 45%. Secondly, 30% of the participants mentioned that they play weekly, 20% mentioned that they play daily while the others 5% said that they never play games. This spread of answers chosen for this could be multiple reasons. One of the bigger factors for this would be that people could be busy with school or work, therefore less time will be available for these participants since other tasks will also be done by them during the day.

Figure 4.4: Results showcasing how often the participants play games.

Following, the participants answered what is their favourite game genre, which 45% answered that their favourite is shooters which could affect their results in the prototype since it involved shooting the enemies, 30% mentioned others which were; quiz games, action role-playing, RPG and the rest said that they do not have a favourite genre. Having one answer be the most common in these questions is not a surprise. This is because Shooters (FPS) games are very popular in the gaming scene. Due to this, it could be one of the main reasons why one answer was very common.

Figure 4.5: Results showcasing the participants favourite game genre.

Moreover, they were asked what type of games they play being a multiplayer and single player. The majority of 40% said that they prefer playing multiplayer games, 35% said that single-player games are their favourite and the remaining 25% said they play both. For this question, the data collected is almost even. There are a lot of people that play games, and different types of games exist which people like. Some people like playing against others to have a more competitive feeling, while others like playing games for their story and explore the game. Due to this having the data spread out like this is not a shock as not everyone has the same reasoning on why they play video games.
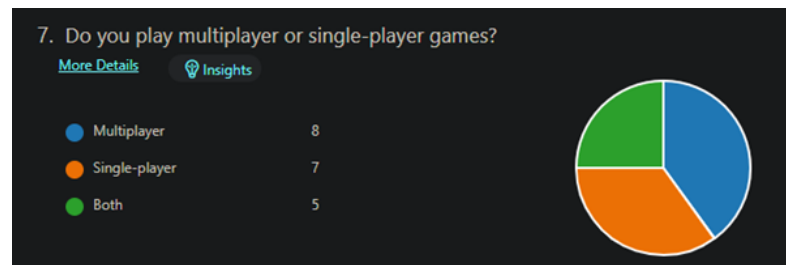
Figure 4.6: Results showcasing whether the participants play Single-player or multiplayer games.

Additionally, they were asked whether their performance in games would affect their daily mood after. This was split 50, 50 between both answers which shows that games could have a good chance to affect the mood of gamers. Games could affect the user in multiple ways, such as have the user in a bad move if they lost because of either not playing up to their expected level, or their team not being as good as they wanted. This could lead to the users being frustrated for a while even after the gaming session ended. On the other hand, if the user is winning while playing video games, this could impact their mood in multiple ways, one being that they are happy for a while after they stopped playing, it could also cause the user to want to play for a longer time as well.
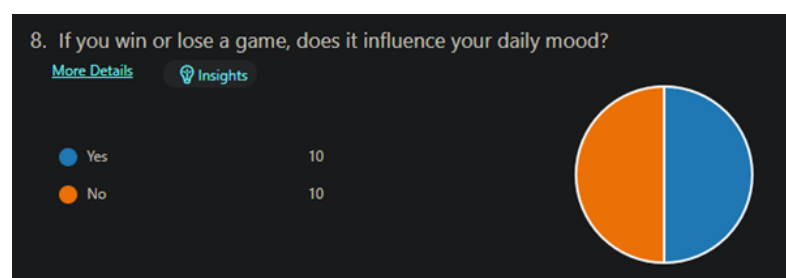

Figure 4.7: Results showcasing if the participants mood is influenced when playing games.

The participants were also asked which device they played on. This was asked to see whether it would impact the results in the prototype which will be discussed

further in this section. Most of the participants which were 60% said that they play games on a computer, 24% listed that they play on a console and the remaining 16% said they plan on a mobile phone. Having Computer as the most popular answer is not a surprise for this question. This is because, in a previous question, the most common answer was shooters being the favourite answers for these participants. Shooters are generally played on a computer as the user will be able to be more competitive due to having more control on aiming during the game. The console is also another popular device which people use to play games, as they are mainly sold for that purpose. On the other hand, mobile phones are not sold to play games, but in the past years mobile gaming has been increasing in popularity and a wider variety of games is always being introduced on this device which doesn't need a lot of accessibility to play on.

Figure 4.8: Results showcasing the preferred device to play on.

The following question was about the reason for the previous question, to determine the reasoning behind their answers. Although this was an open answer, there were two common responses which were that they want to play with their friends and the preferred controls of the devices. Some other answers were that they played on a specific device since they were young, in this case, the participants choose the computer, and since they do not play a lot, they have a cheaper device to play on. From the total of 20 participants, 4 of them said that they feel comfortable and preferred controls as their reasoning for the devices. On the other hand, 3 of the participants said that they play on said devices because of their friends. A total

of 5 participants mentioned that they play on these devices as most of the games they play are only available on the device they selected.

A question regarding why the participants like video games were asked. Most answers which were 8 from the 20 participants mentioned that they play video games for entertainment and having fun in general. This could be because most of the participants that took place with the help of the data collection for this study play games casually and not competitively.

Participants were also asked if there was anything they don't like about video games. The most common answer was that it could be time-consuming. Some participants only mentioned that game can be time-consuming while others said that it's because of getting used to different controls from one game to another, and also that it takes time to get good a certain games. Other participants mentioned that they get frustrated playing games if they lose a lot, while others said sometimes they feel like repetitiveness and also game-breaking bugs which wouldn't let them advance in the game.

4.2.3 Results about the prototype

The participants have presented questions about the prototype to gather more data alongside the data from the prototype itself. Firstly, they were asked if they knew platformer mechanics or features. This was done to determine if previous knowledge about platforms impacted the results. A total of 55% of participants said that they were not familiar with them, while the remaining 45% said they were. The platformer genre is not one of the most popular genres in the gaming world. Even though it is not, it still consists of very popular games such as the Crash Bandicoot game series. Crash Bandicoot games are very popular in the gaming scene by both regular gamers and by people that do not play a lot of games. This could be the reason why the answer to this question is almost even, why having a
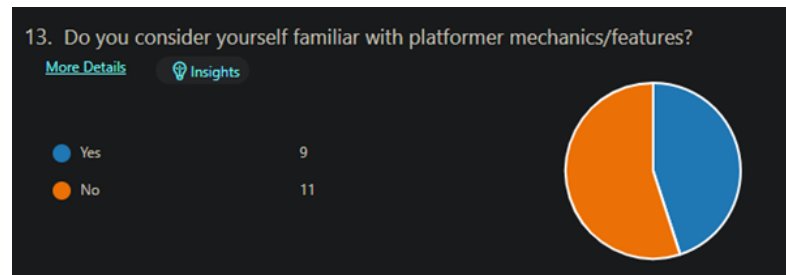
platformer genre, not as popular as others.

Figure 4.9: Results showcasing if the participants are familiar with platformer mechanics.

When asked whether they enjoyed playing the prototype, 19 of the participants which result in a 95% said that they did enjoy playing the prototype, while one participant said that we're not enjoying the game. For the prototype, it was well planned on the assets which will be used, what features to implement to the game as well as the game design such as the structure of the levels. Different people like different aspects of the game, which could be the assets in a game, the game mechanics, and the features presented in-game. This could be one of the main reasons why most of the participants answered Yes to this question.
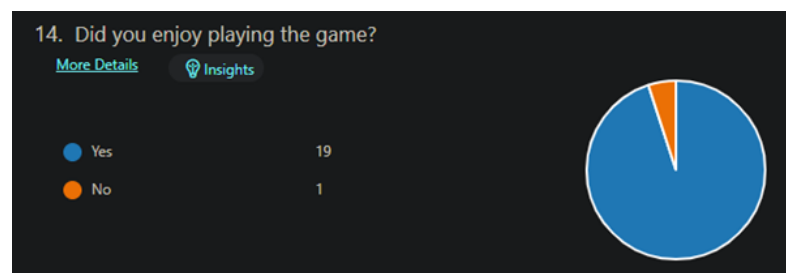

Figure 4.10: Results showcasing if the participants enjoyed the prototype.

Following these questions, they were asked if the difficulty of the game was adjusted to their gameplay. This question was very important as it will be analysed with a question later regarding their motivation with playing the prototype with the help of the dynamic difficulty adjusted implementation. For this question, 90% of the

participants said that the difficulty of the game was indeed adjusted to their skills while the remaining 10% said that the adjustment was towards their skill during the gameplay. While implementing dynamic difficulty adjustment into the game, there were different changes done while testing it with multiple testers that did not take part in the survey. These testers did not take part in the survey as they would likely answer Yes in favour of the prototype since they helped build it to their liking. With the help of multiple testers that have different skills in games, this could be the reasoning while the implementation of DDA was thought to be adjusted towards most skill levels of the participants.
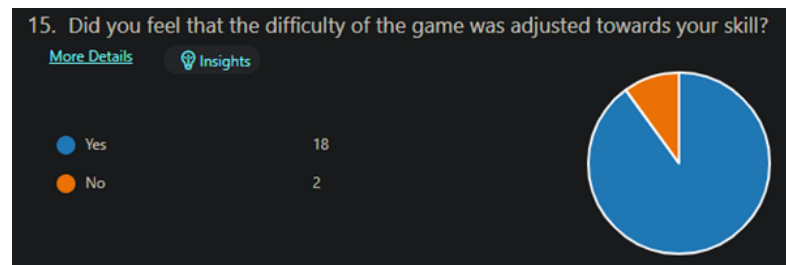

Figure 4.11: Results showcasing if Dynamic Difficulty Adjustment was adjusted towards the participants skill.

4.2.4 Participants motivation during the prototype

The participants will now be asked question regarding their motivation while playing the game and if any features helped them improve the motivation to keep playing the prototype. Firstly, a question was asked if they felt motivated while playing the prototype in general. This could because of numerous reasons, and results will be used to help analyse the data later. A total of 85% of the participants said that they felt motivated while playing the game while the remaining 15% said that they did not feel motivated. Motivation in video games can be achieved in a lot of ways. Examples of this could be art style used, type of animations used in the game, little side quests for the user to do while playing the game and more. In

the prototype, it was made sure that the art style stayed consistent, having animations and effects for every user interaction and background animations to make it feel more immersive. There was also an implementation of gems in the game which did not have a purpose, but more of a side quest to the user if they wanted to go for them. To add to this, there was also the implementation of dynamic difficulty adjustment which was adjusting the difficulty depending on the player's performance. All these different implementations could have easily made feel the user feel motivated to keep on playing the game.
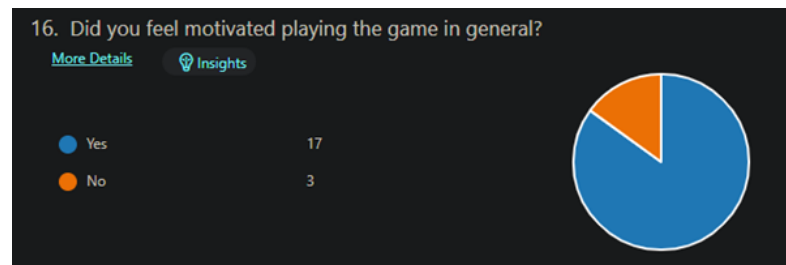

Figure 4.12: Results showcasing if the participants were motivated playing the prototype.

The participants were asked to rate how the implementation of dynamic difficulty adjustment affected their motivation while playing the prototype provided. This is one of the most crucial questions in this questionnaire since it will gather data directly from the participants on whether DDA can indeed improve the player's motivation. From a total of 20 participants, the average score of this was 3.25. The participants could choose between 1 and 4, for this reason so the participants had to lean on one side and not select the middle option to try and gather as much data possible to be analysed later. As mentioned earlier, testers for the prototype were used before presenting the prototype to the participants to make sure the adjustment of the difficulty was done properly. Since dynamic difficulty adjustment is used to improve the overall players experience in-game since it will constantly adjust the difficulty of the game depending on the player's performance

this could be the reason why the average number to this question was 3.25 while having 4 as the highest possible number possible.
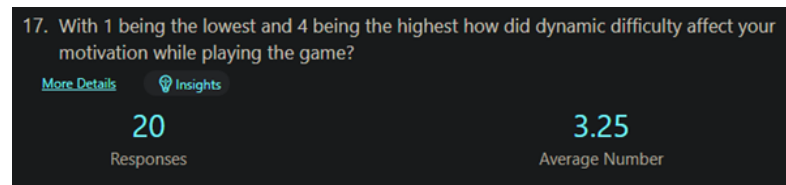

Figure 4.13: Results showcasing whether Dynamic Difficulty Adjustment affected the participants motivation.

Participants were also asked if any other features helped them stay motivated while playing the prototype. A total of 55% said that other features did indeed help them stay motivated while the remaining 45% said there were not any other features to help with the motivation during the prototype. In a previous question, the participants were asked if they were motivated overall playing the prototype. As explained earlier there are a lot of different features on how motivation for the user can be achieved in video games. This shows with the previous question that dynamic difficulty adjustment still had a very high average number, it was not the only reason as to why participants were motivated while playing the game.
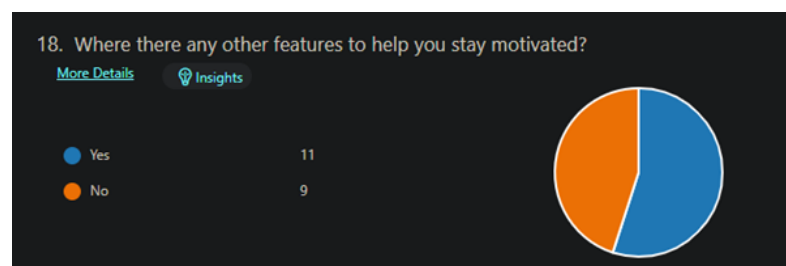

Figure 4.14: Results showcasing if there were other features that affected the participants motivation.

A section was also provided for the participants if they wanted to leave any feedback or general comments about the prototype. Most of the comments were to say what the assets used, the design, the layout, and the game, in general, was like. Some

other feedback was that the game design was liked and that it was unique from their experience. Another participant noted that they stayed motivated to keep on playing the game even though they kept dying several times while trying to get to a certain point. One of the participants mentioned that they wish that there was a purpose for the gems they pickup. While planning the prototype an idea did cross my mind to have a purpose for the gems, but since this study is to determine whether dynamic difficulty adjustment can affect the player's motivation, I did not want to add features that could influence the results. This helped since more accurate data was gathered because any features could affect the motivation as much.

4.3 Game Data

The participants game data was also collected alongside the questionnaire. The game data collected was the kills each participant had, total deaths, gems they collected, the difficulty they ended on and the predicted motivation. This data will be analysed and compared to the data given by the participants in the questionnaire if they were motivated and if the difficulty adjustment was implemented properly. From the collected data from all the participants, the highest total death was 47, while the least was 0. There were two participants that had a total of 0 deaths, and the highest death gave feedback that they were exploring the map and was not rushing to finish the map. They mentioned that they died by falling off the map more than getting killed by the enemies themselves. The average number of deaths of the participants is 8.95, while the median is 5.5. An average is a big number due to the participant that was exploring, as the second-highest death was that of 22. Other participants mentioned that they had some deaths by falling off the map and not dying because of the enemies.

Secondly, one of the important data collected was the total kills. The highest kill count by the participants was 72, while the lowest was that of 58. This data was

important for the implementation of the dynamic difficulty adjustment because if the participant were avoiding the enemies, it could be that they are not confident enough to kill every single one of them if they had the option not to. Therefore, adjustment to the difficulty was done to make it a bit easier, but it was also not solely dependent on this variable. The average number of kills was that of 66.1, while the median was 67. This time the median was higher than the average which means that there were more players that had a similar experience in playing these types of games. A total of 6 participants had their total kills of 70 or more which heavily affected the median and average results.

Thirdly, the total gems collected was also used to help determine whether the participants were motivated or not while playing the prototype. Even though the gems were not the main part of the study, they could still affect the motivation of the participants while playing the prototype. The average number of gems collected was 8.95, while the median was that of 9. For this data, both the average and median have the same results. Even though some participants collected a total of 4 gems, and others collected 13, the results of the average and median remained the same which shows that there was a wide variety in the pickup of the gems.

As mentioned earlier, the final difficulty that the participants finished on was also collected. The medium level of difficulty was the most common with a total of 60%. Secondly was the easiest level with 30% followed by the hardest difficulty of 10%. As per the results collected in the questionnaire directly from the participants, 90% said that they felt the difficulty adjustment was done in a way to represent their skills, while 10% said that they did not feel the adjustment was towards their skills. The two participants said the adjustment was done properly; the final difficulty of these participants was 'Easy' which could be that the game was too easy for them. The remaining 90% had different difficulty levels at the end, ranging from easy to hard.

Finally, the predicted motivation of the participants was also collected which will be analysed with the data provided by the participants themselves. A total of 65% was calculated to be motivated while playing the prototype, while the remaining 35% was not motivated. The participants had to answer if they were motivated while playing the game which 85% said they were and the remaining 15% said they were not. This means that the calculations were not 100% accurate, reasons for this can be if the participants were exploring the game which could of lead them to die by falling off as noted by one of the participants, others might have been seeing how much damage they take from the enemies resulting in having less health when needed.

Chapter 5

Conclusion

5.1   Research objectives

This research paper aimed to identify if Dynamic Difficulty Adjustment (DDA) can help players motivation while playing video games. Based on the quantitative and qualitative analysis that was done and compared, it can be concluded that DDA can improve players motivation while playing video games. The results indicate that most of the participants with different skill levels saw that their motivation was improved regarding the DDA implementation.

5.2   Research Questions

In the Introduction, three research questions were defined which wanted to be answered during the research done. As shown in Chapter 4 in the methodology, the results show that most of the participants were indeed motivated during the prototype with the help of the implementation of dynamic difficulty adjustment. In this Chapter, the results gathered from both the questionnaire and the prototype shows that most of the participant's difficulty in-game was adjusted according to their skills. This means that the way the adjustment was done in the prototype was not affecting the participants with having the difficulty adjusted and resulting

in having a bid difference immediately. Moreover, the adjustment in the difficulty was done between each level. This was done so the change in difficulty would not happen when the players were fighting against the enemy AI.

5.3   Reflection on the research

In the research, the argument whether Dynamic Difficulty Adjustment or the traditional game difficulty choices were the better options. This was discussed in Chapter 2 which highlights all the points that back up each side of the argument. This was a very important part in the research since it is seeing if dynamic difficulty adjustment can help players be motivated in video games, therefore all the reasoning behind each point was taken into consideration when implementing DDA in the prototype to gather results. Alongside this, research was done about DDA in general which shows what changes in difficulty should be done, when such changes should be done and how to implement a good DDA for a game. Also, research about players motivation was done to help gather as much information as possible which was used when building the prototype. This helped to improve the players motivation as much as possible.

5.4   Recommendations

Based on these conclusions, further, development can be done on this prototype to improve the Dynamic Difficulty Adjustment (DDA). Improvements to this can be that there will be two sides of adjustments done in the prototype. Firstly, the current DDA will stay implemented with the possible further arrangement in the implementation since not all participants felt the adjustment was done correctly. Secondly, an adjustment of difficulty can be implemented to have each level change regarding the player's performance. As mentioned, when discussing the data, some participants mentioned that some of their deaths came from the falling of the map

because they could not make the jump. Therefore, if the players are not managing to do the jumps, the adjustment in the difficulty would be implemented to help these players. This could be done as mentioned earlier by changing the levels to have easier jumps, or also implementing powerups such as jump boost to help the players. This could also help improve the player's motivation as they will not be stuck in one place for a long time.

5.5   Contributions to knowledge

The study was mainly focused on whether Dynamic Difficulty Adjustment (DDA) can help with the improvement of the player's motivation in video games. This study shows the research done about how DDA works with the advantages and possible disadvantages, and how a game can improve players motivation. This research was done in the Literature Review Chapter which addresses all the topics related to the study and mentions different sides of the topics. This was done so a clear picture of this study was done before the prototype was constructed.

With the help of the results that were achieved during the research, one can say that with the help of implementation of DDA in a video game can indeed improve players motivation in video games. This is because the players will be able to play the game without having to try out different difficulty modes to find the right one for themselves, but instead having the game adjust its difficulty for them.

Through the results achieved in this research as mentioned in Chapter 4, it is proven that Dynamic Difficulty Adjustment can indeed help players motivation in a video game if the implementation is done correctly. This involved having the adjustment done at the right time, and what type of adjustments are done.

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