Investigating How Virtual Reality Can Be Used To Develop Transferable Life Skills.

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Table of Contents

Abstract. Virtual reality (VR) has been shown to work successfully in teaching technical skills to employees in workplace environments. However, there are still very few VR games that dabble in teaching transferable life skills, such as cooking. This dissertation explores the possibilities of using VR for teaching these important skills. A VR cooking simulator was developed in Unity and offered to a group of ten participants to experience. The participants played the artefact in a controlled environment that had ample space for the participants' freedom of movement. Following the testing, each participant was given a questionnaire to fill out which would gather their thoughts on the artefact. Most of the questions provided used a 10-point scale for the answers, with the remaining questions using a 3-point scale or requiring long-form answers. The data collected from the questionnaires was compiled into graphs and analysed. The results showed that every participant thought that the prototype was successful in some degree. From the data and the analysis, it can be concluded that there is potential found in VR games for being practical in teaching transferable life skills.

1 Introduction

The proposed project is one that will investigate how virtual reality (VR) can be used in tangent with simulation games to create a suitable learning environment for the player to gain unknown skills. This project will be specifically looking at how the theory and skill of cooking can be learnt from a VR simulation.

Due to the current cost of living crisis in the United Kingdom (UK) (BBC News, 2023), it is more important than ever that people can get by on a lower budget. Cooking from scratch is often known to be cheaper than buying pre-prepared meals, tasting better and going further (Melissa, 2016). The project will focus on young adults, primarily students. Surveys have been taken that show that students often rely on frozen and microwaveable meals (Shaw, 2022) compared to cooking from scratch. The project will aim to develop these skills in a fun and easily manageable way to aid in healthy eating and self-sufficient money expenditure.

The developed artefact will be presented to willing participants of the target audience to play, following with a questionnaire about their experience with the prototype. From the results of the questionnaire, a conclusion will be formed discussing the benefits and drawbacks of the experiment. Furthermore, the conclusion will later determine if the theory of the study can be applied to alternate skill sets and used outside of the study's target demographic.

2 Aims and Objectives

2.1 Aims

Students are typically perceived by the public to be bad at cooking, resorting to buying takeaways and microwaveable meals every day. However, provided with the correct help and materials, these stereotypes could be demolished for good. This dissertation aims to investigate how a virtual reality game could be used to teach cooking skills to those who need it. Student participants will be invited to play through the created game, where upon completion, they will be asked a series of questions about their experience with the study. The results of the study will be used to decide whether the future of learning transferable skills through VR games is practical or not.

2.2 Objectives

1. Research topics surrounding the study area, such as immersion, gamification, and related case studies.
2. Develop a virtual reality cooking simulator game that can be used to aid in the investigation.
3. Gather participants to assess the created artefact.
4. Discuss the results of the investigation.

3 Literature Review

The literature review will delve into the main relevant topics regarding the study subject. These topics will range from case studies of previously published VR games to how VR is incorporated within the workplace, along with how an effective learning environment can be created by implementing immersion and gamification. In addition to these topics, the review will also have research on the cooking abilities that students hold and how the layout of a kitchen can affect the effectiveness of the cook.

Firstly, the literature review will discuss and analyse some of the immersion techniques that are present within the VR application case studies. By reviewing the different immersive techniques primarily, the report can delve deeper into the case studies and find their strengths and weaknesses.

3.1 Immersion Techniques

According to the Cambridge dictionary (Cambridge Dictionary, 2024a), immersion can be defined as 'the state of becoming completely involved in something'. It is a process where the player temporarily expands their consciousness into areas of unconsciousness, while keeping consciousness, like lucid dreaming (Wirtz, 2023). In video games, this brings the player out of the 'real world' and transports the brain into a different reality. Immersion can be achieved via several characteristics, including storytelling, interactivity, audio, visuals, and non-playable characters (NPCs) (Tanskanen, 2018). These characteristics can be grouped into two categories, richness, and consistency (Madigan, 2010).

3.1.1 Richness

Richness includes areas related to cognitive activity and sensory information to create an immersive environment for the player.

3.1.1.1 Cognitively Demanding Environment Cognitive demands involve new tasks, solving routine problems and confronting unpredictable developments (Meyer and Hünefeld, 2018). By placing the player within a cognitively demanding environment, the developer can ensure that the player uses their mental resource on exploring the game world (Madigan, 2010). This technique will draw the player's attention away from any shortcomings present in the world that would serve as a reminder of the reality of their environment.

3.1.1.2 Complete Sensory Information The more complete an environment is with sensory information, the fewer blanks that the player will have to mentally provide themselves (ibid.). Similarly to cognitively demanding environments, should the player feel the need to think deeply about missing information, the chance of the immersion breaking increases.

3.1.1.3 Multiple Channels of Sensory Information Multi-sensory means using more than one sensory channel at one time to perceive information about the environment (Croner-i, 2020). Immersion has the potential for creation through stimulating multiple senses in a singular instance. Furthermore, engaging the player via multi-sensory interactions can deepen their involvement in the story (Rachael, 2023). Phasmophobia (Kinetic Games, 2020) prominently uses this characteristic by combining auditory cues and visuals to create an eerie atmosphere for the player, heightening immersion.

3.1.1.4 Interesting Story/Narrative Producing an interesting and strong story will provide context for the world, making an environment appear more believable to the player. Immersion via storytelling can be defined into three types: emotional, spatial, and narrative immersion (Rachael, 2023). Establishing an emotional connection between the player and the characters is an essential part of any story. By doing so, the player will develop a bond with the characters that should motivate them to engage with the story and the characters actively. Spatial immersion can be triggered and kept via spatial qualities in the environment, such as deliberate camera movement and auditory cues (Zhang, Perkis, and Arndt, 2017). Narrative immersion involves the player in a way that allows them to become deeply engrossed in the story by focusing on the characters, the plot, and the world-building (Rachael, 2023).

3.1.2 Consistency

Characteristics that are related to consistency include interactivity, harmonious visual cues, unbroken presentation, and consistent behaviour throughout the game world.

3.1.2.1 Interactivity Interactivity in games can be defined as how the player experiences the environment of the world, the story, and the mechanics via distinctive features (sheehrozeameen, 2017) (University of Silicon Valley, 2019). Additionally, the Cambridge Dictionary defined interactivity as 'the involvement of users in the exchange of information with computers and the degree to which this happens' (Cambridge Dictionary, 2024b). Immersion through interactivity is possible by giving the player feedback on their actions to create a believable environment (Madigan, 2010). Rock Band 4 (Harmonix Music Systems, 2015) achieves interactivity through the controller simulating the instrument present within the game.

3.1.2.2 Harmonious Visual Cues Unharmonious visual cues draw the player's attention away from the experience, reminding them that they are playing a game and are not physically within the environment, breaking the immersion (Madigan, 2010).

3.1.2.3 Unbroken Presentation A broken presentation of the world will draw the player out of the immersion by temporarily taking the world away from the player via various means, such as loading screens (ibid.). An example of a game avoiding this is Monster Hunter: World (MH: W) (Capcom, 2018). MH: W supports an unbroken presentation through its lack of loading screens throughout the main gameplay loop. This feature was an innovation from the earlier instalments in the franchise, which contained loading screens between each zone, disrupting the flow of gameplay and immersion (Flik's Gaming Stuff, 2018).

3.1.2.4 Consistent Behaviour The seamless and logical organisation of the game's features make the game consistent (Temba, 2013). The believable behaviour of objects and

characters plays a part in this (Madigan, 2010). Without consistency, players will actively notice all illogical happenings within the game, drawing them out of the immersion.

3.1.3 Immersive Learning

As well as being extensively used within a gaming setting, immersion is also used in learning environments. Immersive learning can be defined as 'the active construction and adaption of cognitive, affective, and psychomotor models through artificial experiences that are perceived as non-mediated' (Dengel, 2022). These models mentioned are also known as domains of learning, named by Benjamin Bloom in 1956 (Hoque, 2016). The cognitive domain involves the development of intellectual skills and knowledge, the affective domain involves feelings, values and attitudes, and the psychomotor domain involves physical movement and using motor-skill areas (Arkansas State University, n.d.). Individuals are placed in an interactive physical or virtual learning environment to simulate real-world scenarios and teach skills and techniques (Strivr, 2023) (Training Industry, 2023). Including immersion within the dissertation project will aid in its ability to teach new skills or to build upon existing ones. Additionally, the nature of the project being in VR will add to the effectiveness of the project's immersion. VR can appropriately create interactive, experiential environments (Guerra-Tamez, 2023).

One example of an immersive learning environment is the Cadaviz, a virtual human dissection table (Immersive Labz, 2023a). The system features a complete anatomy with interactable 360-degree 3D visualisation, allowing the user to visualise every part and structure in detail while simultaneously taking part in a realistic dissection (Immersive Labz, 2023b). Additionally, the system caters to the medical curriculum and has quizzes and practical experiments for the users to engage in. The same company produces another product called SimuLab (Immersive Labz, 2023c), which is a virtual science lab intending to gamify science practical experiments to increase learning potential.

3.2 VR Games

Some of the first VR games were released in 2016 when VR became more accessible for customers to buy (Balasubramanian, 2023). Since then, a wide variety of different VR games of varying genres have been published, ranging from rhythm games like Beat Saber (Beat Games, 2019) to first-person shooters like Half-Life: Alyx (Valve, 2020). The literature review will continue by looking into a handful of VR games that have already been published. The chosen games will be analysed to decide what makes them successful and how different features of each game could prove beneficial to the created artefact.

3.2.1 Cooking Simulator VR

Cooking Simulator VR (GameBoom VR, 2021) is as it says on the tin, a VR cooking simulator game. Discussing Cooking Simulator VR is essential for the artefact's development due to the number of similarities between the two. The player finds themselves in a kitchen, with ingredients, utensils, and crockery available to create food dishes, following the recipe book and then sending the food out to the customer. The player is then given feedback on the dish on what they did right and wrong, along with a rating out of five.

While the recipes in Cooking Simulator are created based on real-life recipes, they have been adapted for the virtual world to achieve accessibility and entertainment (James, 2023). This means that the recipes cannot be directly applied to the real world, with

quantities, timings and techniques potentially needing to be adapted on conversion. If the game featured cooking times like those in the real world, the game would be slow and uninteresting. The player is unlikely to want to wait around doing nothing for ten/fifteen minutes while the chicken is cooking.

Rush Reality is a YouTube channel that specialises in VR content (Rush Reality, 2020). They published a video where they played Cooking Simulator VR and then tried to recreate the same dish in the real world (Rush Reality, 2021). To keep the test fair, Rush Reality chose a dish they had previously eaten but had never made themselves. Selecting a dish that met these criteria meant that there was a reference point for each of the five senses. The video starts with Rush Reality choosing kung pao chicken as the recipe, followed by Rush Reality creating the dish in Cooking Simulator VR. The video develops into Rush Reality following the same recipe in real life, using the exact ingredients and quantities as specified within the game. They slightly adjusted the cooking times to avoid uncooked chicken. During this segment, the viewer can easily see that the measurements of the ingredients in Cooking Simulator VR are inaccurate in real life. The ingredients for the sauce were not enough, creating more of a paste than a sauce, while in comparison, the chilli flakes for the chicken were too much, using an entire bottle of chilli flakes. Throughout the end of the video, Rush Reality expressed that the dish they made did not taste good, "I could eat it, I wouldn't enjoy it" but that it did look like the dish they created in the game.

As seen in the video, Rush Reality could follow the recipe from Cooking Simulator and make an edible dish. The video suggests that the recipes within Cooking Simulator VR could be used to learn cooking from. The use of simplified recipes is something that the developed artefact should look to incorporate. By including simple recipes, the player will not feel out of their depth and confused in what the next step includes. The use of shortened timings is a feature that needs to be incorporated to keep the game fun. However, this would simultaneously be unhelpful in the overall scope of teaching players real-life cooking skills. The project could look to have a fast-forward button to keep the game flowing while still conveying the correct information to the player. Alternatively, the artefact could convey the correct timings as previously mentioned but automatically use shortened timings within the game to keep gameplay flowing.

3.2.2 Job Simulator

Job Simulator (Owlchemy Labs, 2016) is a VR game that is set in 2050, when robots have replaced human jobs. The game places the player in a simulation of what human jobs used to be like, including but not limited to owning a store and working in an office.

The game itself has no story, instead, each simulation has roughly twenty tasks for the player to complete (Allen, 2023). The tasks can be completed however the player sees fit, giving the player free rein to unleash their creativity. Furthermore, between tasks, the player can do whatever they want to, including throwing and breaking items. This feature provides the player with plenty of freedom. This freedom aids in supporting immersion in the game despite the player not following any rule sets.

Job Simulator was designed so that limitations on playing space would not affect the player's ability to interact with the world. All the necessary items and objects are placed within arm's reach of the player, while environments have areas that are interchangeable (Davis, 2019) (Allen, 2023). One example of this is within the chef simulation, where the player can toggle between a fridge and a pantry with the flick of a switch.

Giving the player the freedom to conduct tasks how they see fit may be fun in a game like Job Simulator, but for the scope of the project, could be a hindrance. While recipes and techniques often have many different and unique ways to be conducted, the project's target audience is students who are beginner chefs. They will need more guidance in the methods that they should be using. Similarly, the ability to toggle between workstations in the chef simulation helps with the space limitations that some VR players may face and increases interactivity but may hinder the immersion due to the break in the believable environment (as discussed in section 3.1).

3.2.3 Phasmophobia VR

Phasmophobia (Kinetic Games, 2020) is an online co-op psychological horror game. Players find themselves gathering paranormal evidence from haunted locations, with the overall aim of naming the ghost existing in said location (Phasmopedia, 2023c) (Gluth, 2020). The game uses several features within its gameplay to increase the immersion for the player, from voice recognition to sound frequencies.

The voice recognition artificial intelligence (AI) allows the players to directly communicate with the ghost via a spirit box and a Ouija board (Phasmopedia, 2023b). On the contrary, the players may accidentally prompt the ghost to elicit certain behaviours via phrases spoken in general conversation, such as "I'm scared" and "run" (King, 2020). The voice recognition can work both for and against the players, aiding them in investigating the ghost while simultaneously raising the risk and likelihood of the player's demise. The AI is always listening to the player, waiting for the correct phrases to be said to create more dire consequences.

As discussed previously, in section 3.1, immersion can be created by stimulating multiple senses in a single instance. Phasmophobia achieves this using visual cues and audio. The audio within the game has been designed in such a way to keep player adrenaline high while keeping a heightened sense of immersion throughout (Barzola, 2021) (Kamaraj, 2022). As displayed in the video cited, (Power, 2023a), the ambience changes once the player enters the building. Once inside the threshold, the outside ambience disappears, leaving only a low frequency of audio to play. A handful of the larger maps in the game have additional ambience concerning their setting (Holland, 2022). Sunny Meadows (Phasmopedia, 2023a) is a map within the game that replicates a mental institution. While playing in this location, ambience sounds unique to this map can be heard, as shown in these video clips (Insym, 2022) (ChickyTV, 2022) (ChickyTV, 2023). These map-exclusive sounds make the experience more immersive, reminding the player of the situation of the environment that they are in. The visual cues work in tangent with the audio, stimulating multiple senses at once while simultaneously providing the player with in-game clues as to the gameplay that may unfold in the upcoming minutes. A couple of the visuals present include the lights flickering during a ghost hunt and the ghost throwing objects around the house, giving the player clues as to where the ghost is existing (Phasmopedia, 2024). The visual cues that the game owns remain harmonious throughout, never pulling the player out of the immersion.

3.3 VR in the Workplace

In addition to gaming, VR has more recent applications and implementations in real life. VR has become more prominent in training programs in the workplace in recent years (Murad, 2023). A study from 2022 (Likens and Mower, 2022) discovered that VR learners

were four times faster to train compared to classroom learners. The VR learners were 275% more confident with applying learnt skills following training and 3.75 times more emotionally connected to the content at hand.

VR is used in several industries to provide practical experience while limiting the risk of injury and error and minimising the cost of training overall (Ghoshal, 2023). Training simulations can be used in many practical areas, such as the police force or aviation pilots. Industry workers can use VR training to familiarise themselves with machinery or practices present in their workplace.

3.3.1 Derby Police

Derbyshire Constabulary officers were the first in the country to use a virtual reality platform to aid in the training of taser devices (Thompson, 2020). AVRT (Adaptive Virtual Reality Training) is designed for the training of several sectors, including emergency services, high-risk operatives, and the military (AVRT, n.d.[a]). The system places the officers in several unique scenarios that are increasingly realistic than those previously staged. The weapons that the officers use within the simulation are like those used in real life, with the ability to be holstered in existing equipment and providing haptic feedback to the officers (AVRT, n.d.[b]). By using equipment within the virtual world, the officers will be training with the same equipment they would use in real situations. Using similar equipment means that the officers can perform to the best of their abilities, using the experience gained from the VR training to form instinctual, second-nature responses and reactions. Platform instructors can control the scenarios in real time to create situations where the participants must adjust their strategy to fit the evolving circumstance (AVRT, 2023). Using VR training for police simulation is advantageous; there is a reduced risk of injury and an increased sense of flexibility and replayability. Virtual training also minimises the cost of training, with less ammunition and taser cartridges consumption; each mock taser cartridge costs £30 each (AVRT Training, 2021).

3.3.2 Rolls-Royce

Rolls-Royce partnered with Qatar Airways to train engineers to support and repair planes and their related parts, such as the engines (Rolls Royce, 2019). The introduction of VR training was brought about due to the increasing number of air passengers and planes that required servicing. Due to the nature of some engineering tasks, it is beneficial to teach them through VR as it minimises damage to both the engineers and the planes, saves money, and frees up engines that could otherwise be used to keep passengers moving. One example is the Trent XWB, Rolls-Royce's largest engine. Due to the size of the engine, it must be separated into parts before engineers can transport it for maintenance. The VR training transports the engineers into the virtual world, where they are immersed in separating the engine while staying in a safe and cost-effective location.

Additionally, Rolls-Royce introduced a VR maintenance training programme during COVID-19 (Sarsfield, 2020). The training programme is set to last two days and provides an overview of the construction and design of the BR725 engine that powers ultra-long range business jets. Upon completion of the programme, participants will own the knowledge to undertake non-routine maintenance and service the engine. The participant is placed in one of two realistic scenarios, with the engine either installed into a G650 jet or stand-alone in a hangar. Rolls-Royce says that these scenarios mimic the scenarios that are used within the in-person training course.

Both training programmes are not intended to replace practical training. Rolls-Royce sees the valuable application of VR training in refreshing the knowledge of engineers who have already completed practical training on the same topic (Rolls Royce, 2019). Rolls-Royce also said that virtual training helps create greater flexibility in how training can be accomplished, as training engines are not specifically required. (Sarsfield, 2020).

3.4 Gamification

Gamification can be defined as a teaching strategy that incorporates game-like elements into non-gaming activities to enhance engagement and motivation (Deterding et al., 2011). Intrinsic motivation is encouraged via the means of gamification (Future Learn, 2021), where the user takes part in an activity due to inherent satisfaction instead of separable consequence (Oudeyer and Kaplan, 2007). This type of motivation is the favourable motivation type according to psychology (Li, 2023).

An experiment that took place in 2018 (Smiderle et al., 2020) investigated how gamification affects learning and engagement in students based on their personality traits (e.g. extroverted and introverted). The study had students complete programming tasks using a web-based system called Feeper. This system uses gamification by employing points, badges, and ranking. Half of the students used the gamified version of Feeper, while the other half used a non-gamified version. The study showed that the students who used the gamified environment had a higher average of badges, points, and logins. The group using the gamified environment highlighted improvement in the quality of the given solutions alongside increased accuracy. The introverted personality types were more engaged than the extroverted personalities, suggesting that gamification is more successful for introverts (ibid.). Looking at personality traits deeper, there is the suggestion that introverted people are more likely to enjoy video games (16Personalities, 2023). As seen in the graph cited, for each personality group, the two introverted personality types agree with the statement "You enjoy playing video games" more. These statistics cannot be taken as gospel as every person is unique and breaks stereotypical personality traits. However, this can be used as a suggestion that the project will be beneficial to its players as they are more likely to be introverted, in theory.

Due to the nature of the project, gamification is a strategy that will prove beneficial. The project should include gamification features and general gaming features in collaboration to produce a "game" which effectively teaches the player.

3.4.1 Duolingo

Duolingo is a language learning application that perfectly highlights how gamification can be successful in a learning environment (Duolingo, 2023). The application has over five hundred million registered users, with thirty-seven million of those being active regularly every month (Daniel, n.d.). A wide range of gamification features are used within Duolingo, including streaks, daily quests, achievements, leaderboards, a life system and many more (Bilham, 2021). These features can achieve elevated levels of user retention while continuously giving positive reinforcement and visible progression (Scacchi, 2023).

3.4.2 Minecraft Education

Minecraft Education is a game-based learning platform that focuses on teaching and building STEM (Science, Technology, Engineering and Mathematics) skills (Mojang, 2023).

The game supports a variety of learning methods, including encouraging collaboration and communication, building confidence and engagement, and preparing students for the future workplace through relevant skills and knowledge areas.

3.5 Kitchen Triangle Theory

The kitchen triangle theory is a design concept that is built around the main work areas in a kitchen (Compusoft, 2023). The primary areas tend to be the sink, the hob/oven, and the fridge. The idea is that by creating a triangle between these primary areas, an efficient environment can be created with an optimised workflow (Everett, 2023). Distance between the focal points should be considered too. The rule specifies that the distances between each point should be between 1.2 - 2.4 metres (4 - 8 feet), while the total perimeter should not be less than 3.9 meters or exceed 7.9 metres (13 - 26 feet). Limiting the size of the triangle to this scope allows for minimal moving between each point, while simultaneously providing enough space to avoid cramping (CliqStudios, 2023). More triangles can be included within the kitchen to incorporate more areas of the kitchen, such as a food preparation station (Compusoft, 2023).

The kitchen within the game willimplement this theory to create an immersive experience for the player, imitating the benefits that have been explored previously. The primary areas of the game's kitchen will be the hob/oven, the fridge/pantry and the preparation area.

3.6 Student Cooking

There is a common stereotype that students cannot cook for themselves (Linder, 2023), with several surveys backing this stereotype up. A survey from 2013 (Denham, 2013) discovered that one in ten students never cook for themselves while at university, while a quarter of the surveyors will buy a takeaway at least once a week. Similarly, a survey from 2020 (Wunsch, 2021) asked participants in age groups whether they agreed or disagreed with the statement "Do you lack the skill to cook from scratch?". Within the 18 - 24 age group, $\approx$ 40% of the surveyors agreed with the statement (either somewhat agreed or strongly agreed), compared to 37% of the surveyors disagreeing with the statement at hand. Additionally, $\approx$ 24% of the surveyors neither agreed nor disagreed. Two Point Studios and SEGA created a survey which questioned over 2000 UK graduates on their dietary habits (Shaw, 2022). This survey found that a quarter of surveyors relied on frozen food, with an added quarter relying on microwavable meals.

While the first survey mentioned is from a decade ago, the other two surveys support the same findings, with a substantial number of students who do not cook for themselves or do not feel capable of doing so. Since the surveys show comparable results while simultaneously taking place seven to eight years apart, means that it can be deduced that a lack of student cooking skills is not a new concept.

The data presented within these surveys shows that if the project is successful, it will help many people, primarily those in university or of that age range. The project should be able to teach them some basic skills that will provide them with enough to get by or to develop an interest in the area, which would lead to them teaching themselves new and more intricate knowledge.

4 Research Methodologies

Based on the literature review that has been previously undertaken, the ultimate question that needs to be answered is:

Can an individual learn to cook through a VR video game?

4.1 How Will the Research be Conducted?

To aid in the research and study of this project, an artefact prototype will be created with the aim to provide insight on the question at hand. This artefact will be in the form of a VR cooking simulator game which will focus on teaching the player how to make spaghetti bolognese. The simplicity of this recipe makes it the perfect, beginner-friendly choice for the study. The full recipe makes four servings and only has nine ingredients in total, with only three being fresh produce, meaning that the overall cost of the dish is low. A survey from 2022 (Brown, 2023) found that 18% of students use food banks and 82% of students worry about making ends meet due to the rising cost of living. By ensuring that the recipe highlighted in the prototype is accessible, the study can hope to help reduce the number of students that rely on alternative solutions to access food. Going beyond the study, the recipe for bolognese is one that can be easily adapted to make other dishes, such as chili con carne and shepherd's pie.

Willing participants will be invited to play through the prototype within a controlled environment in Staffordshire University's Mellor building. Each participant will have the chance to play through the VR prototype created, where they will be tasked with making a dish of spaghetti bolognese. To ensure that the data collected from the experience can be analysed efficiently, all participants will be students or recent alumni of Staffordshire University. In addition, this will ensure that the participants fall under the target demographic for the game.

Upon completion of playing the prototype, the participants will be given a questionnaire to answer. Most of the questions within the questionnaire will be answered using the 10-point survey scale. This scale was chosen over the 5-point and 7-point Likert scales due to the wider spread of options which will be more appropriate for reviewing the prototype (Khandelwal, 2021). The first question, however, asks the participant to answer on a 3-point survey scale on how confident they were with cooking prior to the experience. A 3-point scale was chosen here as the question is only intended to gather a feeling on the participants experience and prevents the participant from struggling to pick an answer from a larger scale. Furthermore, by having the participants answer on a number-based scale, the responses can be directly translated into graphs and figures to enable easy comparison between each participant. It will be easier to directly analyse numbers and figures compared to thoughts and feelings. However, a few of the questions ask the participant to answer using a few sentences, or to elaborate on their chosen number rating. The purpose of these questions is to interpret the feelings of the participant to have a better understanding for their reasoning, alongside gathering information on how the prototype could be improved for future use.

4.2 Artefact Design

4.2.1 What Does the Artefact Need to Include?

Due to the nature of the study, the artefact should remain as faithful to real life cooking as possible. Failure to do this will result in the artefact falling short in completing the aim of the study. To ensure that the artefact mimics real life cooking, several distinctive features which have been previously discussed in the literature review must be included.

Immersion will be the overarching feature that will need to be included. Throughout the literature review, immersive learning was discussed multiple times. In section 3.1 which discussed immersive techniques and immersive learning, and in section 3.3 which discussed how VR has been used in a workplace environment. As shown in section 3.3, VR learners were four times faster to train and were significantly more confident and emotionally connected than those who were learning from within a classroom. These statistics may differ from those in this study due to the artefact still being in a prototype-like state throughout the participant testing stage. However, matching these statistics is the goal of the artefact throughout its lifespan as this will prove that the artefact is practical, and that the ultimate question previously stated can be answered truthfully.

VR and VR headsets in themselves are already immersive, which will aid in the overall immersion of the experience for the participant. (HeizenRader, 2023). Alongside this, immersion will be implemented further with audio and visuals. As discussed in section 3.1, immersion can be created and kept through consistent behaviour, harmonious visual cues, and complete sensory information. Within the artefact, correct models for ingredients and objects will be used where possible, and the recipe that the player follows will be identical to the recipe that the author uses in real life. The recipe being correct to that of real life is important so that the study can be conducted effectively. In section 3.2.1 , the literature review discussed how the recipes in the game did not translate well to real life cooking due to the gamified ingredient measurements and time scales. Audio immersion will contribute to the complete sensory information that should be present in the environment. The immersion that audio can create can be seen in Phasmophobia VR (section 3.2.3), where the game uses several types of audios to manipulate the player's emotions and provide in-game information. There should be audio that plays throughout the experience that is correct to real life. These could be the sound of the knife cutting the vegetables, or the sound of the meat frying in the pan.

In section 3.4 of the literature review, intrinsic motivation and methods of gamification were discussed. Gamification was shown to have a positive effect on learning and engagement, which is one of the biggest focus points of the artefact and of the study overall. Due to this, gamification will play a huge part in the success of the study and in the viability of the project. The artefact can adopt many different gamification features, some of which may be present in the prototype, and others that are more ideal in the artefact's future. One of these gamification features is a bell ding audio clip that will play upon the completion of each ingredient being cooked. This will provide the player will real-time feedback on when the ingredients are cooked, especially as the time measurements on the recipe provided are not exact to those in game, for the reasons mentioned previously.

4.2.2 What Will the Artefact Include for Measurement?

The artefact itself will not include any features that can be used for measurement, such as a timer or a scoring system. This is because the prototype should not be stressful for the player, as this will hinder both the immersion and the learning potential. Stress has been shown to hinder memory recall, attention span and cognitive functionality (Córdova et al., 2023). Instead, the artefact will be measured by a questionnaire that will be completed upon each participant's completion of the prototype, as previously mentioned. The results

of the questionnaire will be discussed and analysed in section 6, alongside graphs and figures that will be compiled from the numerical data collected.

4.3 Artefact Implementation

4.3.1 Game Engine

Before development could begin, the game engine that would be used for the project would need to be decided upon. The two choices that were considered were Unity and Unreal Engine 5. These engines were considered due to how accessible they are, with free user plans and plenty of documentation. After some consideration, Unity was decided upon as the game engine of choice for a couple of varied reasons.

Firstly, the author has had plenty of earlier experience in using Unity during their previous year at Staffordshire University. This experience extends to including mixed reality development in Unity, creating a VR bowling game (Power, 2023b) (Power, 2024) and several AR mobile applications. Utilising Unity in this project would ensure that all the development time available could be used effectively and efficiently instead of spending part of the available time learning how to implement VR within Unreal Engine 5.

Additionally, Unity as an engine will be better suited for the creation of the project, in comparison with Unreal Engine 5. Some of the reasons behind this decision are specifically related to XR development while others are more generic to the engine itself.

As of 2023, Unity grew to two million monthly active users that were using Unity to develop games and interactive experiences (Periera, 2023). In comparison, as of 2023, Epic Games said that over 750,000 users were actively building projects with Unreal every month (Dealessandri, 2023). Based off these numbers alone, in 2023 Unity boasted a big $\approx 266\%$ more active users than Unreal. From the larger community that Unity boasts, it can be determined that there would be more online support in the medium of forums, with dedicated members of the community provided help and support to those who ask for it. While this will not be absent within the Unreal community, there are significantly less people that are available to provide this help, along with the divide between blueprint developers and C++ developers. This factor was heavily considered in the decision of which engine to use. Having access to a large community for support is always helpful, but especially so when developing a project in a more niche genre, such as XR. This was shown to be useful in the development of the project. Community support was needed in the initial set-up of the XR-Rig to ensure that the player was able to move and look around as intended. Furthermore, the large community of Unity developers led the discovery of the slicing mechanic that was implemented in the game, which will be discussed in section 4.3.2.4.

Unity and Unreal both own their own asset stores for their developers to use to sell and buy assets. As of the time of writing, Unity Asset Store is advertising 93111 unique assets (Unity Asset Store, 2024a), while Unreal Marketplace is advertising 42684 unique assets (Unreal Marketplace, 2024a). When filtering to only free assets, Unity advertises 8658 assets (Unity Asset Store, 2024b) while Unreal only advertises 1238 assets (Unreal Marketplace, 2024b). As the artefact is only a prototype at this point, using free assets is ideal compared to paying copious amounts of money for paid assets. Having access to a larger pool of these free assets will allow for more creativity in designing the environment and provides more potential to find acceptable assets for specific topic of cooking. Furthermore, in the future of the artefact's development past the study at hand, it would be preferable to hire an artist to create assets for the game rather than pay for pre-existing assets to ensure that a consistent art style is supported throughout.

There were a few other comparisons that were discovered while deciding which engine to use that were not considered in the final decision due to their irrelevancy to the project.

While both Unity and Unreal support a variety of platforms for development, as of Unreal Engine 4.24, Unreal no longer supports HTML5 web publishing (XR Bootcamp, 2022). WebXR is a browser API that allows XR hardware to work on the websites (Miller, 2022), giving the player access to many different outlooks, including gaming and social media. On a similar note, Unity often receives platform features and extensions before Unreal does (XR Bootcamp, 2022). The Oculus Quest hand-tracking feature is a prime example. The feature was originally released in beta to Unity in late 2019, with the full version being released in May of 2020 (Lang, 2020). The feature was only pushed to Unreal in June of 2020, a full month after Unity received the post-beta version.

4.3.2 Changes During Development

The state of the final prototype is relatively like what the original idea was. However, as expected, there are some areas and features which changed throughout development.

4.3.2.1 Recipes What could be considered the biggest change during development is the recipes themselves. Originally, at least two recipes were to be implemented, the spaghetti bolognese which is present in the final prototype, and a chicken curry. By including more than one recipe, it would give the participants a sense of freedom in what they decided to cook, a factor that translates over to real life, where each person gets to freely choose what they want to eat each day. The chicken curry recipe would not have differed much from the bolognese recipe, with the only differences being the meat and some of the spices. The focus of the study is looking at how a VR cooking game can teach cooking in real life, so quality is by far more important than quantity. Inevitably, the curry was cut from development to keep the integrity of the prototype.

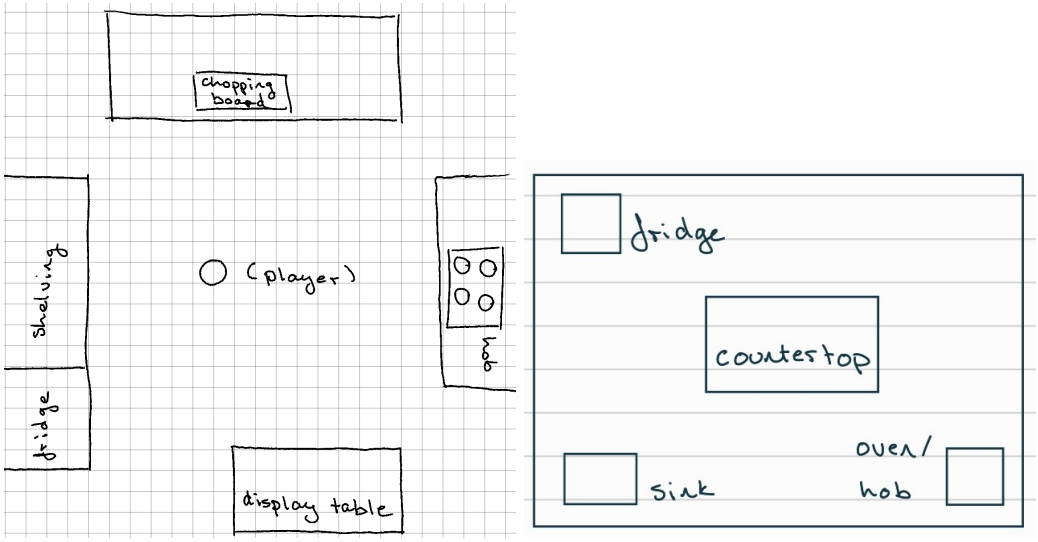
4.3.2.2 Post-Game Quiz Another consideration for the game was including a quiz at the end. This was inspired by the gamification found in Duolingo, which was discussed in section 3.4.1. Upon completion of the dish that was being prepared, the participant would receive an in-game quiz that would recall and strengthen the participants' knowledge. However, this idea was discarded as it was not needed to create the minimum viable product (MVP) and would have created more non-essential work for the completion of the prototype.

4.3.2.3 Interactable Environment In the design phase of creating the artefact, the environment was planned to have been incredibly interactive, with the player being able to interact with all the cupboards and utensils. The cupboards would have been able to be opened in the same way that the fridge is open-able in the completed artefact, and the utensils would have been able to be held by the player. During the development of the prototype, it was decided that the amount of interactivity with the environment would be reduced from what was originally planned. Like the post-game quiz, this was due to the feature not being a part of the MVP and was moved into the category of features that would be implemented in future development instead. In the completed artefact, the participant can interact with all the relevant ingredients, utensils, and doors that are needed to complete the recipe.

4.3.2.4 Cutting and Slicing Mechanic The cutting feature was originally planned to be remarkably simple for the participant, where they would place the knife roughly where

they wanted to chop, and the vegetable would be automatically chopped for them. The vegetable would first be chopped in half, and then into cubes, simulating the vegetable being diced. During the research of how to conduct this feat, a GitHub repository was found, called Ezy-Slice (Arayan, 2018). With this tool, the participant has the freedom to cut the vegetables in any way imaginable. This feature could be seen as both an asset and a hinder to the effectiveness of the prototype. It helps the prototype by giving the player the freedom to cut the vegetables however they wanted, as previously mentioned. This will aid in the immersion of the prototype, encouraging the participant into focusing on doing their best in the task. On the other hand, it could be seen as a hinder because of the freedom it allows, if a participant does not know how to dice a vegetable, then they may struggle in identifying what this process should look like.

4.3.2.5 Kitchen Design and Layout The design and layout of the kitchen changed a couple times through both the development and pre-development phase. As discussed in section 3.5, placing the primary areas of the kitchen in a triangle will create an efficient environment for the user.



(a) Original Kitchen Design (b) Improved Kitchen Design

Fig. 1: Pre-Development Kitchen Designs

Figure 1a and figure 1b show a couple of the kitchen designs that were initially drafted up. Additionally, figure 1a was created before any research within the literature review was conducted, which can be assumed due to the lack of implementation of the kitchen triangle theory.

The original design for the kitchen (figure 1a) placed the player in the environment, surrounded by different areas of the kitchen. The player would have had access to a chopping board, a hob, a fridge, a cupboard, and a display table. In hindsight, this design, if implemented, would have struggled to keep the player immersed, as the layout of the kitchen is so far from what a kitchen tends to look like in real life, breaking that sense of realism and familiarity. Figure 1b improved upon the original design by taking aspects of the kitchen triangle theory. The design cut the display table and cupboard shelves that were present in the original design. A sink area was also introduced in this design.

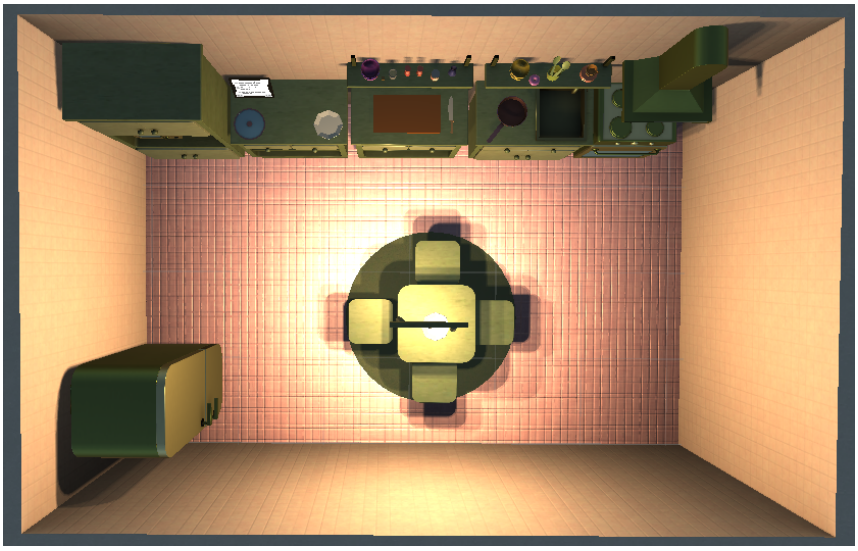


Fig. 2: Kitchen Design Present in the Artefact

Figure 2 shows the final design of the kitchen, which is the design that is present within the finished prototype. The kitchen triangle theory can be seen in both figure 2 and figures 1a and 1b. The similarities between 2 and figure 1a are not as prevalent as those between figure 2 and figure 1b. This is to be expected as figure 1b was the design that was used to inspire the final design. In figure 2, the fridge has been placed in the bottom left corner, with the hob being placed in the top right corner. These primary areas form two of the three points of the triangle. The chopping board is the final main area, being placed between the fridge and the hob, to form a non-equilateral triangle. As discussed in section 3.5, the total perimeter of the triangle should be between 3.9 and 7.9 metres. Calculating distance like this within a virtual world is difficult, but throughout development and participant testing, it can be determined that walking this distance in the real world does not exceed 7.9 metres.

4.3.3 Bug Testing

For a solo developer, it is important to regularly evaluate the program or artefact being developed to ensure that bugs and issues can be discovered and fixed in an efficient manner. By leaving all the bug testing until the end of development, the developer runs the risk of discovering game breaking issues which are not easily fixable. Additionally, by ensuring that each mechanic is bug free as development is happening, the developer results in creating a set of sound mechanics that can be used in other projects without issue.

Following this logic, regular testing of the artefact was conducted throughout the entirety of development. This was beneficial for the artefact overall as it meant that more time could be spent on polishing the artefact at the end of development, instead of trying to fix issues which were ignored throughout the main development.

In addition to the developer evaluating the artefact throughout development, the prototype was shown to a handful of external people a couple of times throughout development. These people were able to play the game without the knowledge of all the ins and outs and were able to discover some blaring issues which were overlooked previously. A fresh set of eyes overlooking the artefact prior to participant testing was certainly helpful to the prototype.

5 Results and Findings

A total of ten people took part within the testing phase of the project. All participants were either students or recent alumni at Staffordshire University, as previously mentioned in section 4.1. The testing was partaken within the Mellor building at Staffordshire University, with each participant playing through the prototype game on an HTC Vive Pro VR headset. This provided consistent results that were not influenced from the headset or environment being used.

It should be noted that one participant ceased their participation about half-way through the gameplay due to a bout of cybersickness. However, the participant observed the full gameplay of the prototype while another participant was playing, and filled the questionnaire out, accordingly, based on their experience in VR and the gameplay that they witnessed.

5.1 Quantitative Data

Most of the questions asked within the questionnaire were using a 10-point survey scale, as mentioned in section 4.1. The data collected through these quantitative questions have been compiled into a series of histograms which display the data clearly and concisely. The first question, which was asked on a 3-point scale, has been compiled into a pie chart due to the limited range of answers the participant could give.

It can be seen in figure 3 that most of the participants did not perceive themselves as confident with their previously owned cooking skills. Only 30% of participants viewed themselves as already confident with their cooking abilities.

Figure 4 shows that the participants viewed the prototype as more informative overall than not, scoring a mean average of 7.4.

As seen in figure 5, all the participants felt that the prototype would be beneficial in one way or another at teaching someone the basics of cooking. The mean average score was 7.6.

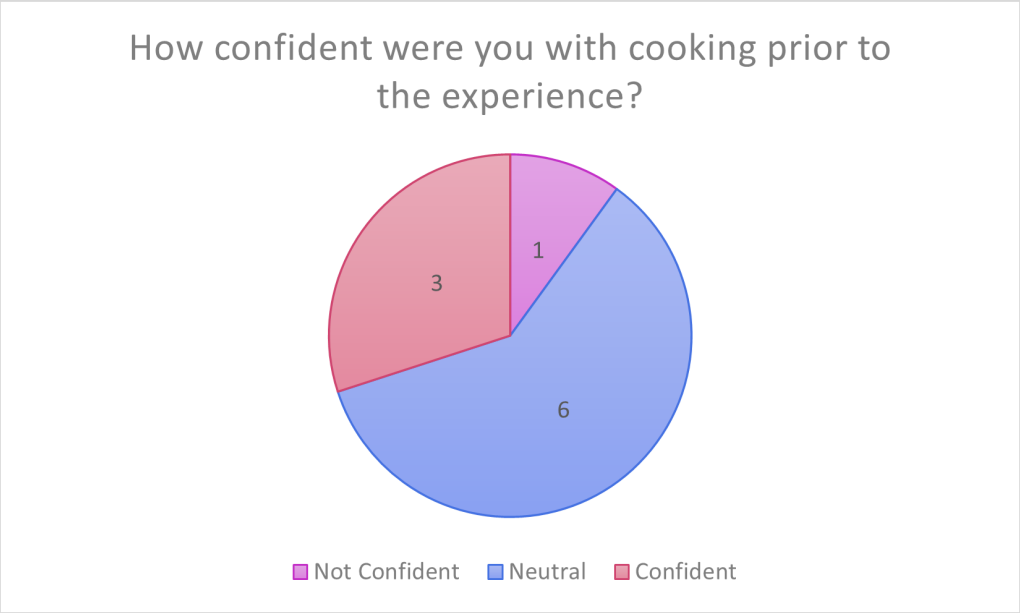


Fig. 3: Participant Confident Levels Prior to the VR Experience

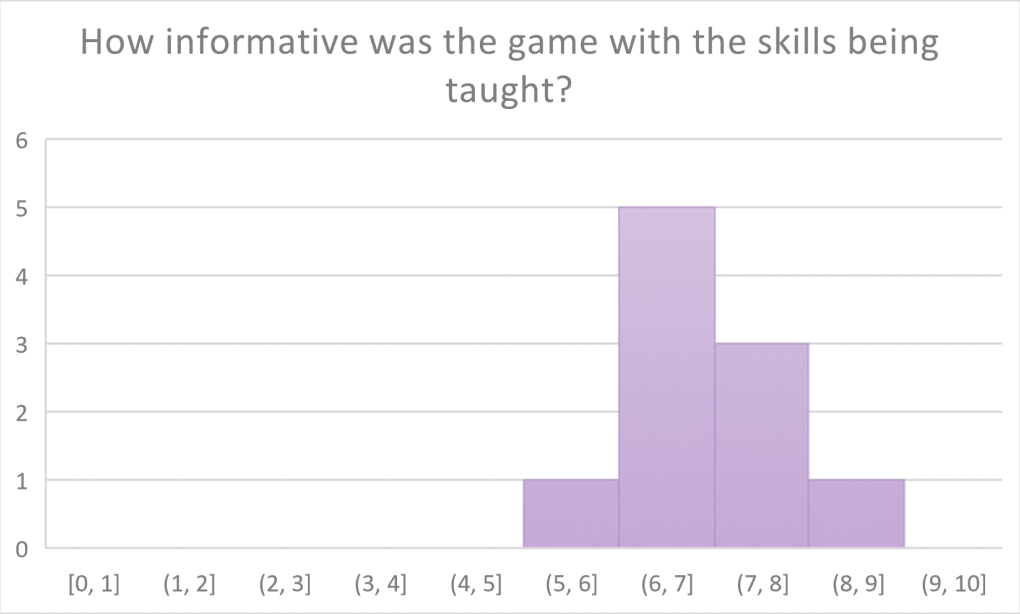


Fig. 4: How Much Did the Prototype Inform the Participant on Cooking Skills?

The participants were asked how likely they would be to recommend the prototype experience to someone else in the future, as seen in figure 6. The participants were more or less in agreement with how likely they would recommend the experience, with the mean average being 7.8.

As seen in figure 7, the participants were asked how likely they would be to go away and try cooking something new after taking part in the study. 20% of participants responded with a 5, being slightly less than likely to try cooking something new, while the other 80% stated that they would be more than likely. The mean average score of this question was 7.4.

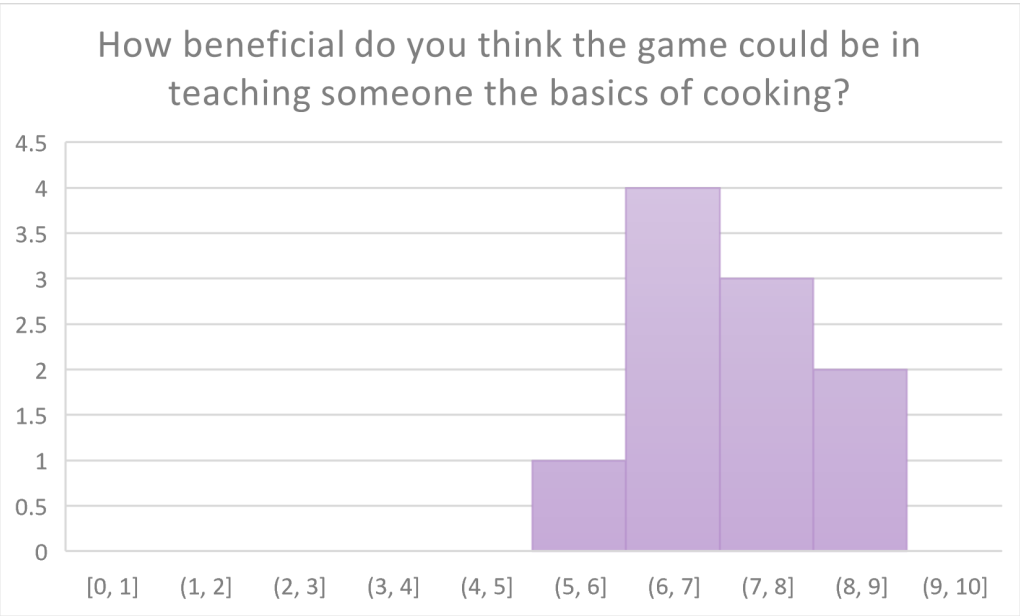


Fig. 5: How Beneficial was the Prototype in Teaching Cooking Skills?

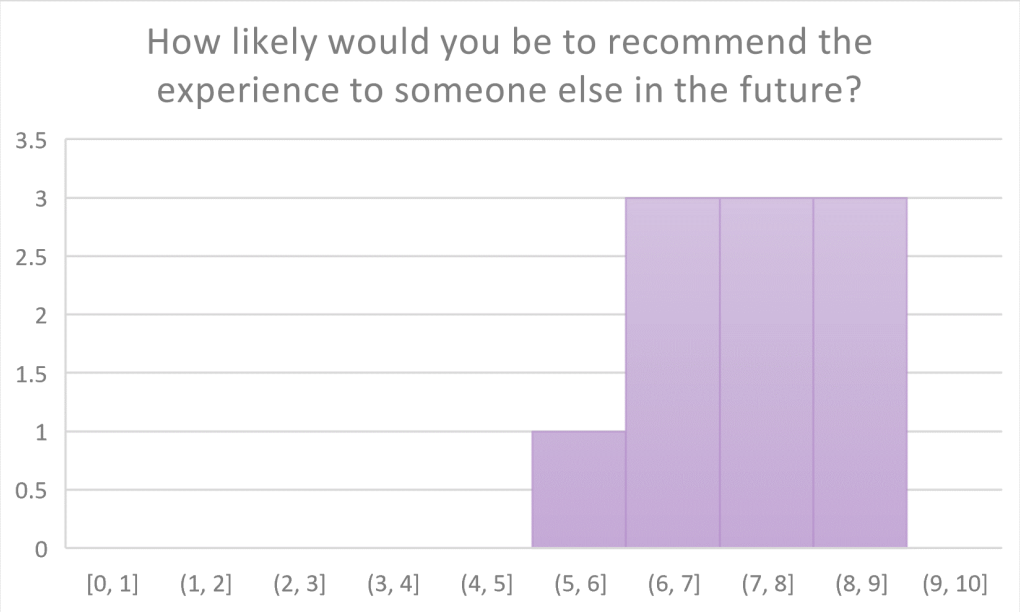


Fig. 6: Would the Participants Recommend the Prototype to Someone Else?

While not so related to the question at hand, as mentioned in section 4, the participants were asked how fun and engaging they thought the experience was. As seen in figure 8, there was an overwhelming number of participants that rated the entertainment value of the prototype as an 8. The mean average score for this question was 8.3.

5.2 Qualitative Data

In addition to the participants being asked for numerical answers, they were also asked a couple open-ended questions which allowed them to put their thoughts into a few sentences.

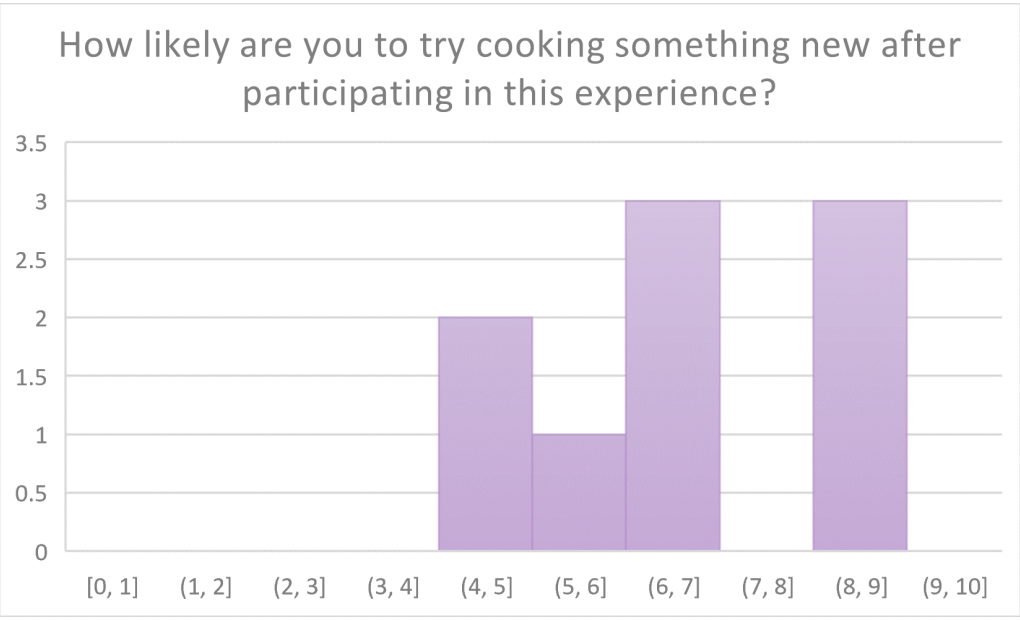


Fig. 7: Would the Participants Try Cooking Something New?

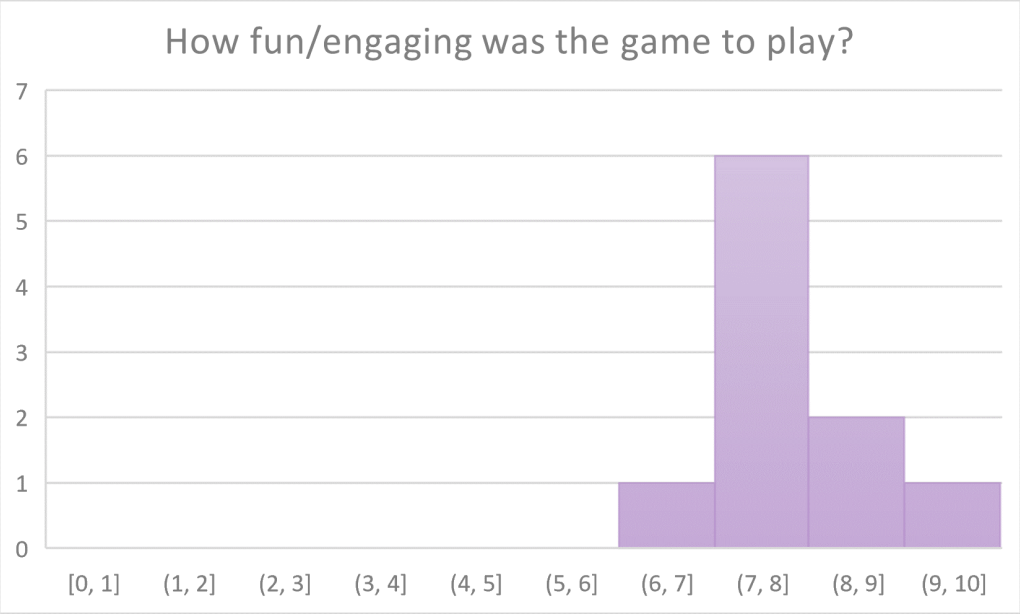


Fig. 8: How Fun and Engaging did the Participants Think the Prototype was?

The qualitative data obtained was coded to find common themes between each participants answer, which was later placed into a bar chart for analysis.

Throughout all ten participant answers, six common themes were detected, as seen in figure 9. The participants liked how immersive, interactive, satisfying, and engaging the prototype was, along with the simplicity throughout the prototype and the slicing mechanic that was used to cut up the vegetables.

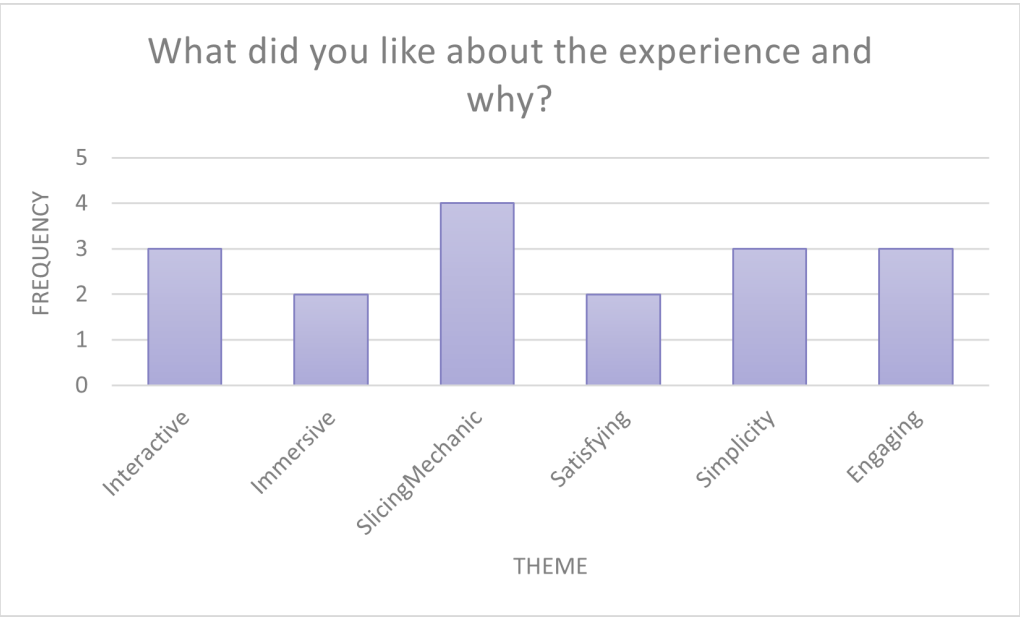


Fig. 9: What Did the Participants Like About the Prototype?

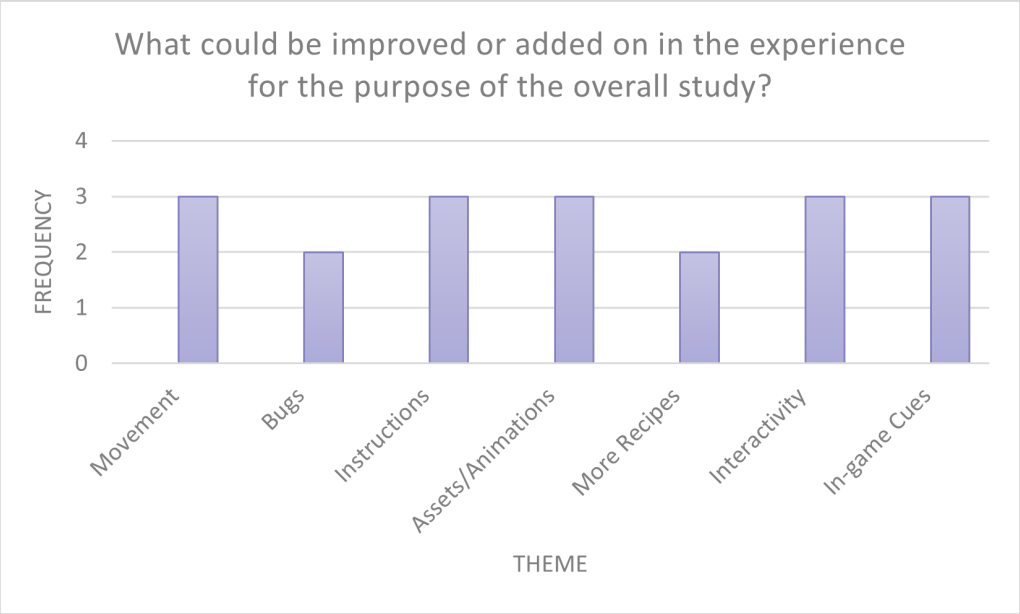


Fig. 10: What Did the Participants Think Could be Improved or Added in Future Development?

There were seven different themes detected from the participant responses, as seen in figure 10. Most of the themes detected revolved around features that could be added in future development, while only a handful was from current issues in the prototype.

6 Discussion and Analysis

6.1 Analysis of Testing Methodology

Overall, the participant testing that was conducted was successful. The study gathered ten individuals who were given the task of creating a dish of spaghetti bolognese in the virtual environment in which they found themselves. The environment provided the recipe that each participant should follow, giving exact ingredients and time measurements in comparison to the real-life recipe. Each participant was given unlimited time within the virtual world to explore and create the dish. Providing unlimited playtime allowed the participants to work in a stress-free environment and spend however much time they needed to become familiar with the controls and the prototype for full effectiveness. Upon completion of the prototype, each participant was provided with a questionnaire to fill out, as mentioned previously.

Gathering ten people for the study ensured that there was a decent sample size to draw results and conclusions. Ideally, the study would have had a much bigger sample size to provide more accuracy and a range of individualistic traits, such as introverts and extroverts or those who already know how to cook and those who do not. Should the project extend into future development, a much larger sample size is a goal that should be achieved to fully understand the potential of the project.

The questionnaire that was provided to each participant was beneficial for gathering the participant's thoughts on the prototype and the study. This was achieved by asking a range of different questions, from how beneficial the prototype was (figure 5) to how the prototype could be improved for future development and study (figure 10). Additionally,

the combination of both qualitative and quantitative research allowed the study to increase the validity of the overarching results. In hindsight, the questionnaire could have asked more questions concerning the study and asked the participants questions before and after the experience.

One specific question in the questionnaire that could have been improved in hindsight was the question that asked each participant about their confidence in cooking before the experience (data found in figure 3. The questionnaire only asked the participant this question after playing the prototype. Instead, the participant should have been asked this question before playing the prototype and asked a similar question like "How confident do you feel at cooking now?" after the prototype. This added question would have provided the study with some data that could have been compared against each other to draw a more concise conclusion on whether the prototype was effective.

6.2 Analysis of Results

From the results of the testing and questionnaire, it can be suggested that the prototype certainly has the potential to be used in an educational setting to teach cooking skills. Some of the key findings of the investigation lie in figure 4 and 5, as these questions were more related to the overall question at hand (mentioned in section 4).

6.2.1 Discussion of the Quantitative Results

The results of figures 4 and 5 were almost identical, where all the results existed between 6 and 9 on the 10-point scale, with a mean average score of 7.4 and 7.6 respectively. Regarding figure 4, 50% of the participants gave the question an answer of 7, while 40% of the remaining participants gave a higher score. These answers show that the prototype was a lot more informative than not in how it portrayed the information for the participants to take in. It can be determined that all the participants believe in the capability of the prototype due to there being no responses that were below a 6. Regarding figure 5, 50% of participants answered with an 8 or 9, showing that they were especially confident in the ability of the prototype to teach someone cooking skills. If the participants did not see the potential of the prototype concerning the study, they would have given much lower numerical answers. The prototype being informative comes hand in hand with the prototype being beneficial, as the whole study is looking at how skills can be taught in VR, which requires informative content to be present to do so. This assumption is backed up by the fact that figure 4 is almost identical in comparison to figure 5. As suggested in section 3.4, different people with different personality types may benefit in unique ways when presented with a game with the intention of teaching. This suggestion could explain the two 6s that can be seen in figure 4 and 5, as it could be quite likely that the same participant gave both of these answers. However, as the study did not collect the personality types of each participant, it cannot be decided whether this lower score was from a more extroverted participant or just a coincidence.

As seen in figure 3, only 30% of the participants perceived themselves as confident in their cooking ability before the experience. This statistic means that most of the participants gathered fell into the target audience that the prototype was intended for, beginner cooks. As most of the participants were of the target audience, it gives some extra validity to the results, in comparison to if the participants were already confident in cooking. From figure 7, more participants answered in the 50% to 75% range of the 10-point scale (60% of participants) than the 75% to 100% range (40% of participants). The mean average

for this question was 7.4, which suggests that the prototype had a positive influence in pushing the participants to cook something new. However, this data could also suggest a flaw in the prototype, where the prototype gives the user the idea to try something new but does not convince them enough to commit to it. This potential flaw may be an area where improvements based on the data sourced from figure 10 will then increase the statistics of this question's data.

The data collected in figure 5 can be used to analyse the data collected in figure 6. Each participant was asked how likely they would recommend the experience to someone else. 30% of the participants answered the question with either 7, 8, or 9, totalling 90% of the participants scoring above 7. The mean average for this question was 7.8, which shows that overall, the participants agreed that they were likely to recommend the experience to someone else. This score could be improved by addressing some of the issues or other features that the participants identified in the question displayed in figure 10.

6.2.2 Discussion of the Future Improvements

During this question about improvements for future development, seven common themes were named via coding the participant's answers. Three of the themes named were concerning the current prototype, while the other four themes were concerning the future development. The themes that apply to the current prototype are "movement", "bugs", and "interactivity". Within the prototype, the user can move around the environment using the joysticks on the VR controllers. However, this method of locomotion in VR is more prone to causing cybersickness due to the in-game character moving while the participant is not moving. This was proven by the participant who finished playing the prototype earlier than expected. On the other hand, locomotion via the joysticks supports the harmonious nature of the prototype in comparison to utilising teleportation-based locomotion. Teleportation points will create unharmonious visual cues for the player, which as discussed in section 3.1, draws the player's attention away from the scenario and reminds them that they are in a virtual world. This issue could be solved in future development by providing the player with the ability to switch between each locomotion mode to match their preferences.

Regarding bugs/issues within the game, these were rare. There was a single bug noted that had to do with the condition checking on the ingredients. When the player pours the ingredients of the spices/sauces, they would enter the pan regardless to whether the player was pouring them into the pan or not. This would be a simple fix of checking whether the GameObject is over the pan or not, identical to how the onions and peppers were checked. The other issue that was present was about the mesh collision on the floor, where objects would occasionally fall through the floor if thrown at a specific angle and velocity. Replacing the mesh collider with a box collider would fix the issue.

When talking about interactivity, the participants expressed that they would have wished that they could have interacted with the surrounding cupboards and equipment more. This is an area of features that were intended to be included, as previously discussed in section 4.3.2.3, that were cut due to lying outside of the MVP. Furthermore, while 30% of the participants mentioned the interactive nature of the environment in their improvements (figure 10), 30% of the participants mentioned the interactive nature in their positives about the prototype (figure 9). This could suggest the possibility of different play styles within the participants, where some exclusively follow the instructions that were provided in the recipe while others go off the beaten path to explore the environment in greater detail.

The four themes that were identified as added future inclusions were "instructions/in-game cues", "more recipes" and "assets/animations". The prototype provided little instruction or cues for the player outside of the recipe was provided. This was intended to make the participant use their critical thinking skills and to remain actively engaged with the scenario. However, based on the data in figure 10, it can be suggested that this was not the right path to take concerning interactive learning. 30% of the participants referenced the inclusion of instructions while 30% referenced the use of in-game cues. Depending on how many participants mentioned both themes in their answer or only one will adapt the total percentage of participants that needed additional instructions, up to 60%. In future development the inclusion of more instructions or visual cues should be present, but with the option for users to customise how much help the game provides them.

The addition of more recipes in the prototype was a feature that was planned and later changed through development, as mentioned previously in section 4.3.2.1. The prototype only needed one recipe for the current study, but more recipes would be implemented in future development. Only 20% of the participants mentioned this issue, however, highlighting that the lack of unique recipes was not a detriment to the study.

Finally, the inclusion of better assets and/or animations was mentioned by 30% of the participants. Due to the study being conducted by a developer/programmer and not an artist, the quality of assets and animations within the prototype was never going to be high quality. The creative outlook for assets was limited to the free content that can be found on Unity's Asset Store. High-quality assets and animations were also not vital in creating the MVP. In future development, assets and animations would be implemented to a higher quality to create a realistic and immersive simulation. Additionally, future development may come with a larger budget that would be used in outsourcing assets from artists, which would also ensure a consistent art style throughout.

6.2.3 Discussion of the Participant Likes

Within figure 9, only one of the common themes was about a direct part of the prototype, while the other five themes were about aspects of the game. The theme that was an actual part of the game was the slicing mechanic. This mechanic was previously going to work differently, as discussed in section 4.3.2.4. This change benefited the whole prototype, with 40% of the participants (as seen in figure 9) explicitly mentioning how much they liked it. 20% of the participants stated that they thought the prototype was immersive which certainly could have been due to the slicing and cutting mechanic. The vegetables dynamically sliced exactly where the participant was placing the knife, just like how they would in a real-life scenario. This creates a realistic element to the prototype which improves the immersion, especially in comparison to the previously drafted idea mentioned in section 4.3.2.4.

Similarly, most of the other common themes shown in figure 9 could also be due to the slicing mechanic. Three of the common themes were each discussed by 30% of the participants, these being "interactive", "engaging", and "simplicity". The simplicity of the prototype is a theme that is unlikely to have been due to the slicing, and more so a portrayal of the nature of the prototype itself. The prototype set out to be simple and easily understandable, creating the most effective environment for beginner cooks. Overcomplicating the prototype would have dissuaded the participants from enjoying the experience. As seen within Cooking Simulator VR (Owlchemy Labs, 2016), the game is simple in nature, with minimal actions being needed for each step while still maintaining a

good level of engagement and interactivity. This simplicity is an area which the prototype strived to achieve, and successfully did so, as suggested by figure 9.

Looking at figure 8, 60% of the participants gave an answer of 8 on the 10-point scale, with another 30% giving an answer of 9 or above, totalling 90% of the participants answering within the top 25% of the 10-point scale. This is shown through the mean average for figure 8 which was 8.3. This suggests that while only 30% of the participants specifically mentioned engagement during the qualitative response in figure 9, the prototype overall was engaging, and that most of the participants had fun during their time in the virtual world. The level of fun and engagement found throughout the prototype can be credited to the gamification features in the game. As discussed in section 3.4, gamification is a teaching strategy that incorporates game-like elements to increase engagement and motivation. While not overly present within the prototype, there were some elements of gamification, such as the bell ding when the ingredients were cooked.

6.3 Analysis of the Artefact

As shown in figure 10, there were several aspects of the prototype that could have been improved or implemented in a better manner. While not being mentioned once in the questionnaire results, the method of the player putting the sliced vegetables into the pan was long-winded and awkward, along with being obscure. Once the vegetables were sliced, the player should pick up the nearby plate with their right controller, and while pointing at the sliced vegetables, press the trigger on their left controller. This would effectively place the vegetables onto the plate, ready for the player to place them into the pan. Throughout the participant testing, every participant, give or take, would pick up the individual parts of the vegetable and try to place them straight into the pan. This caused some redirection being needed, where verbal instructions were given to the participants how to place the vegetables into the pan. This feature may have broken the immersion for some of the participants, which could explain why only 20% of the participants mentioned immersion when asked about what they liked (figure 9). It should be noted that once the participants knew how to place the vegetables on the plate, they did not have any further issues. Additionally, this feature was only needed for the peppers and the onions, so was not detrimental to the whole prototype.

In contrast, a feature which was successful for the prototype was the method of placing the ingredients into the pan. The method used was intuitive, with all the participants naturally using it without even realising. When the player holds an ingredient over the pan and rotates the controller, like tipping ingredients into a pan in real life, the ingredients would be placed in the pan. This creates an element of immersion, where the player feels like they are acting pouring ingredients in. As mentioned in section 6.2.2, there were a couple of issues with the spices and sauce objects not checking their location in relation to the pan, but this can be very easily solved in future development. As shown in figure 9, 20% of the participants mentioned that the prototype was satisfying during the qualitative questions, which could have been influenced from the act of pouring the ingredients into the pan and seeing them start to cook.

During the participant testing, 0% of the participants mentioned the kitchen design layout. As discussed in section 4.3.2.5, the kitchen was designed with the kitchen triangle theory in mind, which was discussed in section 3.5. It can be suggested, due to the lack of being mentioned, that the layout was effective in keeping the participants immersed in the experience and maintained efficiency when traversing around the kitchen.

6.4 Comparison of Results to the Literature Review

In section 3.1.3, immersive learning was defined as 'the active construction and adaption of cognitive, affective, and psychomotor models through artificial experiences that are perceived as non-mediated' (Dengel, 2022). The prototype makes use of two of these learning domains, cognitive and psychomotor. The cognitive domain is stimulated through the development of the player's cooking skills and knowledge throughout the experience. This domain may also be reached through the style of the prototype, where the player does not have many in-game hints and must use their initiative to progress through the recipe. Regarding the psychomotor learning domain, this will be reached using VR alone in the simulation, as the player will have to physically move around the play-space to interact with the surrounding objects. Additionally, the player must move objects around the environment to progress through the recipe. These features combined were designed to increase the level of immersion throughout the experience. This can be suggested through figure 9, where 20% of the participants specifically mentioned immersion in their answers. Figure 4 can also suggest that the immersive learning within the prototype was successful, with a mean average of 7.4 on how informative the prototype was.

Regarding the dissertation topic, "Investigating how virtual reality can be used to develop transferable life skills" section 3.3 discusses how VR is already being used in workplaces to teach employees technical skills. This shows that the use of VR already has the potential to teach individuals specialised skills, such as using a taser in the police force or maintaining a plane engine. Additionally, VR learners have shown to be four times faster to train along with being significantly more confident in their subject area (discussed in section 3.3). It can be suggested from these statistics and the overall use of VR in teaching technical skills, that VR can also be implemented to teach transferable skills. Providing that the statistics still the the same with transferable skills as they are with technical skills, means that the quantity of information that an individual will learn in a set amount of time will increase. This increase in learning capability will aid every individual and shows no clear drawbacks.

7 Conclusion

To conclude, from the results of the participant testing, it has been proven that there is potential for a VR cooking simulator to own the ability to teach individuals the skill and or theory of cooking despite some flaws and limitations. This answers the question asked in section 4, "Can an individual learn to cook through a VR video game?" with a yes. While studies would need to be conducted on each unique skill set, it can also be determined that in an overall scope, VR games can be utilised in teaching an individual transferable life skills. Further studies in this area will continue to develop the viability of using VR as a means of teaching life skills and will eventually branch out into skills outside of cooking.

VR has been capable of being used in workplace environments for years, teaching individuals' technical skills in a range of different jobs (as discussed in section 3.3). VR has also been proven to highlight that learning through VR is quicker than in a generic classroom and provides added benefits such as confidence. However, there appears to be a notable lack of educational VR games that aim to teach transferable life skills. Due to this, the study aimed to investigate how VR video games can be used to teach these real-life transferable skills, specifically the skill of cooking. This was conducted by developing a VR cooking simulator artefact, providing willing participants with the opportunity to play it and answer a questionnaire afterwards. The questionnaire questions were intended to gather the participant's opinions on how informative the prototype was, how beneficial it

could be, what features they liked, and more (as shown in section 5 and appendix A.1). The findings from the questionnaire show that overall, the participants believe in some regard that the prototype would be successful in teaching an individual how to cook. This can be gathered from the fact that most of the data collected exists in the top 50% of the 10-point scale used. From this, the study can conclude that there is potential in utilising VR video games for teaching transferable skills. Additionally, the questionnaire produced some long-form answers about the participant's likes and improvements for the prototype. This qualitative data can be used as a basis for future improvements and development to grow as a project and continue its viability.

7.1 Limitations

Some of the study limitations were discussed in section 6. A notable limitation was the sample size of the participants. While ten individuals are a good starting point for the study, a larger sample size would have ensured more accurate results. Additionally, a large sample size would have provided the study with more opportunity to gather individuals who did not feel confident with their cooking abilities, as compared to the current sample size where only 10% of the participants did not feel confident, and 60% felt neutral about the statement. Furthermore, this particular question on the questionnaire was a study limitation. The participants were asked this question about their confidence levels after playing the prototype. As mentioned in section 6.1, the question should have been asked before the gameplay segment, with a similar question being asked after the experience. This set of questions would have provided the study with a gauge of the confidence improvements from playing the artefact.

7.2 Recommendations

During future studies revolving around this subject matter, the participant testing should be completed on a much larger scale. As mentioned previously, this would provide more accurate results and a range of individuals with unique traits. Additionally, the study could look at gathering participants who are not university students to evaluate how beneficial a VR cooking simulator would be for younger or older members of society to learn cooking. Utilising participants who lie outside of the target audience could also give a gauge of how beneficial a VR simulator overall would be for teaching skills. The participant testing could also be further expanded into a much larger scope, by having the participants cook a recipe in both the real and the virtual world. The participants could play through the prototype as they did in this study, after which they would be placed in a real kitchen with the task of creating the same dish using the same recipes and the same ingredients as the prototype. A potential method for this is to divide the participants in half, with one half playing the prototype before cooking in real life and the other half not. This method would create two data sets for comparison to see how the participants who played the prototype differed from those who did not.

An improved questionnaire should be present for future studies. These improvements could be made by expanding the scope of the questions, such as asking the participant more in-depth questions about the experience or specific features and mechanics present within the game.

Finally, the game should be further developed as necessary to provide a high-quality experience for all participants. The areas that require further development can be found from the data in figure 10, where each participant from this experience noted what they thought could be improved. Most of the areas mentioned concern user experience (UX)

and will be simple to implement. Some of these areas include the locomotion system and the interactivity of the environment.

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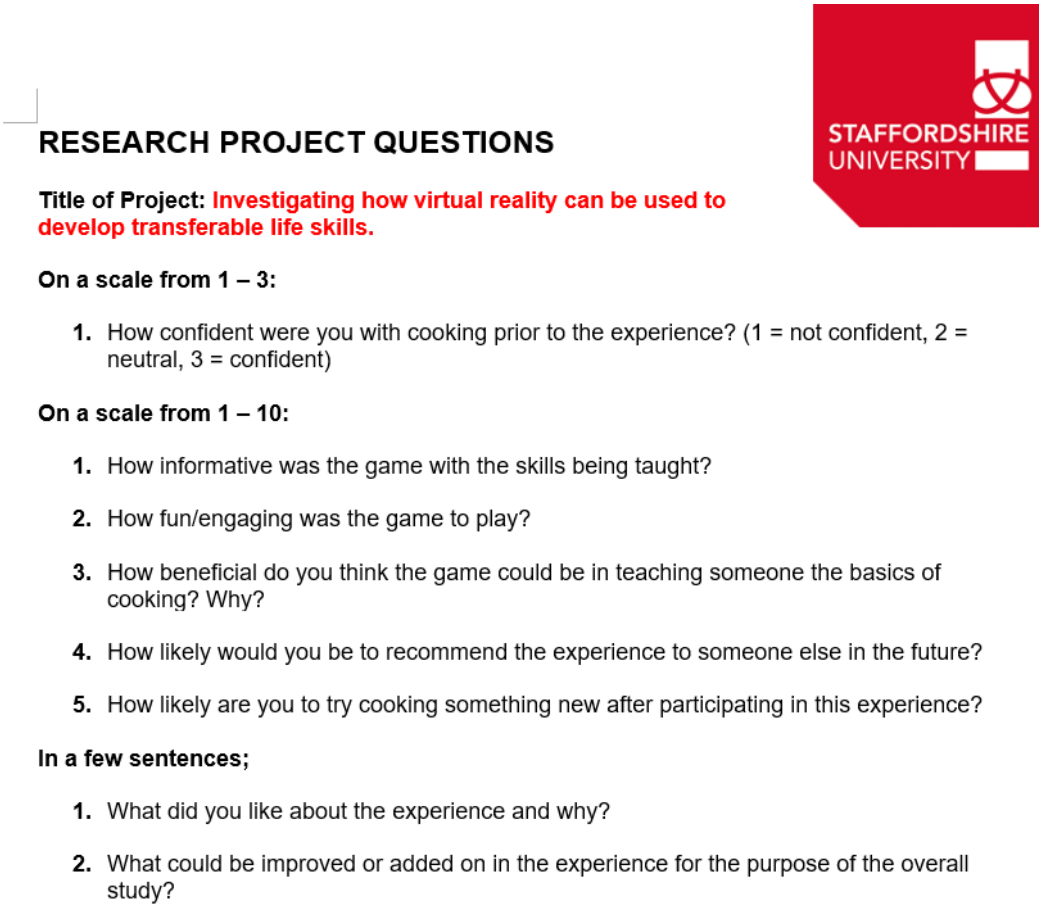
A Appendix

A.1 Questionnaire Questions



RESEARCH PROJECT QUESTIONS

Title of Project: Investigating how virtual reality can be used to develop transferable life skills.

On a scale from 1 – 3:

1. How confident were you with cooking prior to the experience? (1 = not confident, 2 = neutral, 3 = confident)

On a scale from 1 – 10:

1. How informative was the game with the skills being taught?
2. How fun/engaging was the game to play?
3. How beneficial do you think the game could be in teaching someone the basics of cooking? Why?
4. How likely would you be to recommend the experience to someone else in the future?
5. How likely are you to try cooking something new after participating in this experience?

In a few sentences;

1. What did you like about the experience and why?
2. What could be improved or added on in the experience for the purpose of the overall study?