Out of this Planet - An Educational Experience Integrating Intrinsic Motivation

An engineering project

Submitted in partial fulfilment of the requirements for the degree of

Bachelor of Science in Interactive Media

at

University of York

by

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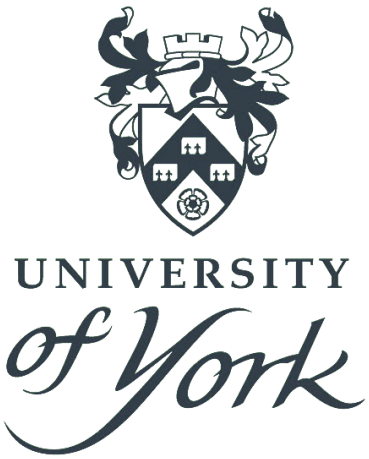

2022

Abstract

Throughout recent years, digital devices have become increasingly popular in the classroom. The use of interactive teaching methods are widespread practice in primary schools, as the positive effects of them have been recognised by teachers and parents. Despite these practices gamifying the experience of learning, the use of actual games in classrooms still receives mixed opinions. This report describes a project to engineer a game that can be used to teach children about a specific topic, using intrinsic motivation to encourage further learning outside of classrooms. Out of this planet is an adventure game created to teach children ages 6-11 about earth and space, using information from the governments national curriculum. Using data gathered from secondary research, the narrative and mechanisms of the game were determined and implemented. This was to create a product that is both entertaining and engaging for the children, yet still aligns with the curriculum to be viable to use in classrooms. To determine the success of this project, user testing was conducted on 4 participants, receiving qualitative feedback, against the projects aims and design requirements.

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Background

Out Of This Planet is a 3D educational game about Earth and Space, for children aged 6-11. The player crash lands on an alien planet and must try to get back home. Along their journey of obstacles and tasks, players learn facts and information about Earth and Space. Players must collect resources, traverse obstacles and complete mini games to reach a spaceship that will take them home. This game integrates the use of intrinsic motivation in order to provide a product that is so entertaining, players forget that this is a learning game, yet still absorb the information.

Figure 1 - Alien planet

Figure 2 - Moon Base

There are many educational games about this topic available to play, however from researching the use of games in school, I have found that there is a lack of games with content that aligns with the educational curriculum. Those that are available tend to fit in the puzzle and quiz genre, which aren't as engaging as adventure and exploration games. BBC Bitesize is great website that uses interactive methods to teach content, and all the information is created using curriculum guides. However, the games on this website are also primarily quizzes. The effectiveness of video games in education seems to be overlooked, even though there are studies that prove its effectiveness. Educational games are more like providing a dimension space for learners, in which learners actively explore and practice, and even forget that this is a learning process (De Freitas, 2018).

Out Of This Planet is targeted towards Key Stage 2 children, as this is age range that the educational content is aimed at. Motivation is they key concept behind this game. How often do children in this age group go to BBC Bitesize when they want to play a game, compared going for a video game? It is commonly surmised that a person is intrinsically motivated to perform an activity when he or she receives no apparent rewards except the activity itself (Deci & Ryan, 2013). This may explain why BBC Bitesize games are used in school and as homework, rather than the children choosing this themselves. On the other hand, video games are played to much due to the entertainment they bring. My aim in this project is to create a product that combines these qualities, to create a product that children choose to play as its entertains them, whilst being informative enough to be used in schools.

Design stage

In order to create a successful product, we must define a set of requirements. Well defined requirements will ensure that all critical features of the product will be implemented (Gotway, 2020). In the project plan, the aims and objectives of this project were determined; to provide an interactive and engaging educational experience for young children, by integrating intrinsic motivation. Now the focus needs to be narrowed down.

Design Approach

Secondary Research

To generate a design concept, desk-based research was used to gather ethical data on interactive learning methods used in schools and home. The data collected from articles, reports, scholarly publishing's and existing interactive educational content were analysed using affinity mapping (Figure 3). Affinity Mapping is a simple technique for organizing concepts: it consists of placing related items together. Participants organize ideas by grouping closely related concept words and phrases, written on cards, into clusters (Hoeppner and Scharf, 2004). The affinity map shows how data was grouped into sections with a colour coded key.

Figure 3 - Affinity Map

The affinity map contains some information from research into educational games, gaming in schools, gaming amongst young people and game design and mechanics. The information has been sorted into different groups such as, popular trends, interactive methods, motivation, game genres and rewards/incentives. I looked into different interactive teaching

method, aside from games, but found the most data on games in education, so I narrowed my focus to this.

The research conducted by Rocha et al (2018) provided some useful information on teachers perspectives of using games in classrooms. They found that 60.6% of the respondent teachers use digital games to support education at least once a month, while 39.4% do not use or rarely use games – see Figure 4.

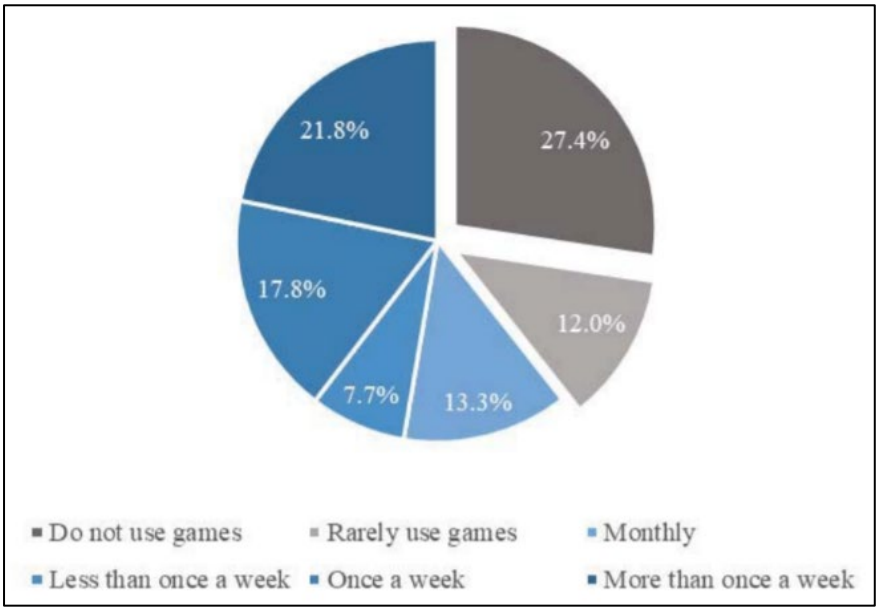


Figure 4 - How often teachers use games in the classroom

They also looked in the reasons why some teachers don't or rarely use games (Figure 5). It shows that the main reasons are due to lack of resources, whether that be technology, time or good games. This highlights the need for a game that can be used on the devices already available, that provides the right content. "Lack of time" was the most common reason, meaning games that can be played at home, outside of school hours, may be beneficial.

Reason to not use games in the classroom	Answers	Percentage
Lack of time	25	19%
Lack of technology resources	25	19%
Lack of good games	22	17%
Lack of knowledge (about the effects, how to use etc.)	17	13%
Games are not useful for teaching	8	6%
Too many students	8	6%
Do not apply to my case	6	5%
Students are not interested	6	5%
Lack of school support	5	4%
Learning is not about having fun	3	2%
Lack of opportunity	2	2%
Laziness	1	1%
Students already use too much technology at home	1	1%
Do not like technology	1	1%

Figure 5 - Reasons to not use games in the classroom

In a survey conducted by Games and Learning Publishing Council (2014), teachers we asked questions about digital devices and games in the classroom, as seen in figures 6 & 7.

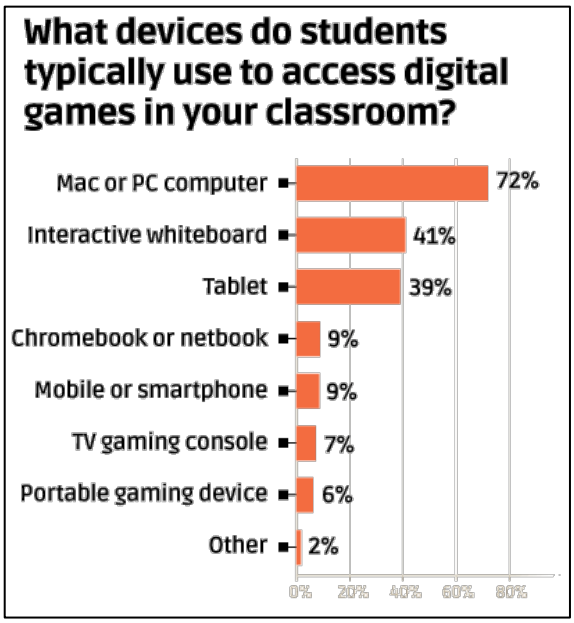


Figure 6

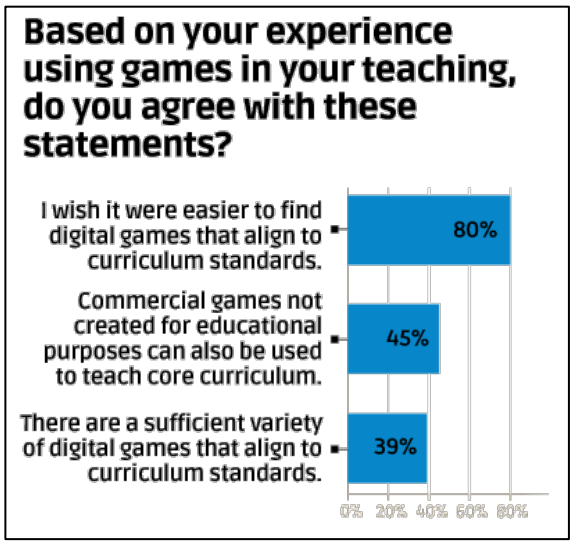


Figure 7

Mac or PC computers seemed to be the most common device used in classrooms with 72% of students using them to access games in the classroom. Mobiles, smartphones, tv consoles and portable gaming devices are used by a very small percentage of studnets, therefore catering to these devices won't be a priority.

Figure 8 shows that 80% of teachers wish it were easier to find digitl games that align to currinculam standards. This is high percentage and it shows that there is a true lack of appropriate educational games.

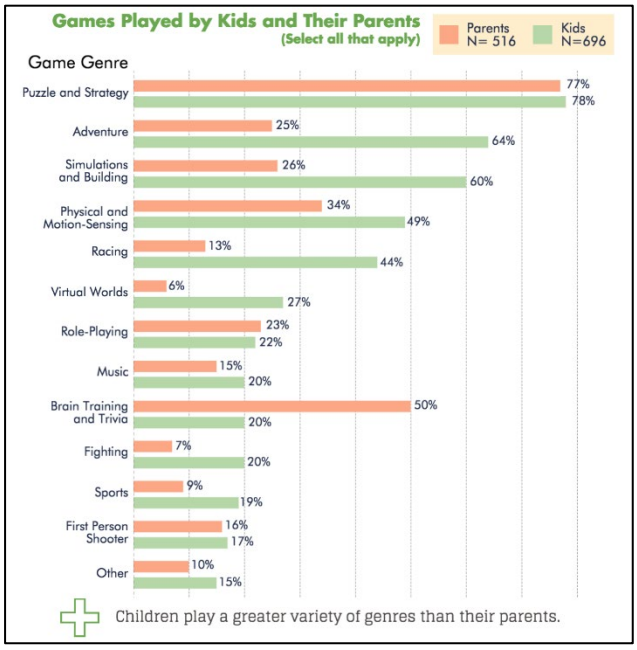


Figure 8 - Game Genres

In 2016, the Joan Ganz Cooney Centre conducted a survey of nearly 700 parents whose 4-13-year old children play video games. These results show what genres of games they and their children play. Puzzle and strategy was the most popular for children, closely followed by adventure and simulations. Brain training and trivia, commonly used for educational purposes, are very low down with only 20% of children playing them.

Design Context

The existing research into educational games and teaching methods provided a lot of informative data for the design. However, it's important that I reviewed existing games and educational experiences that could inform my design. I decided to choose three games and websites that differ in genre and topics to get a wider understanding of which of these would work as an educational, yet entertaining experience. Each of these games are educational but in different ways, and I want to find which method is the most effective.

The Civilization series

Figure 9 - Civilization

Civilization is a series of turn-based strategy video games, centred on building a civilization on a macro-scale from prehistory up to the near future. Civilization takes players to the Ancient Era of 4000 BC and tasks them with building an entire civilization through the ages until 2050 AD at the latest. Players build cities, research topics, build wonders, and more. The research subjects, wonders, world leaders, and city names are historically accurate and will consequently teach players a lot of history on each playthrough.

In studies of naturally occurring online communities of Civ3 players, Squire et al (2006) found that Civilization 3 communities show how participation in them can: (a) introduce players to historical terminology, (b) provide deep understandings of the game as a simulation, (c) increase interest in history and (d) give players a framework for thinking about history. The Civilization games, including the most current version, Civilization IV, have been popular with educators because of their incorporation of historical facts and concepts associated with school history curriculum (Hayes et al, 2008).

BBC Bitesize games

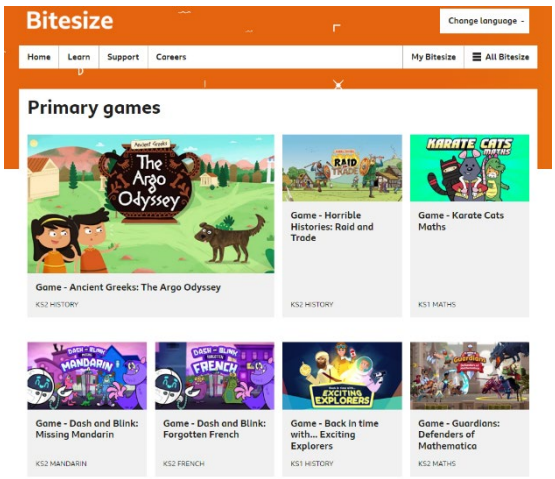


Figure 10 - BBC Bitesize

Bitesize is the BBC's free online study resource for learners aged 5 to 16+ across a wide range of school subjects. Bitesize guides are written by teachers and subject experts and are mapped to follow the curricula of the UK. Primary Bitesize covers core subjects, including English, maths, science, history and geography with animated videos, quizzes and interactive activities such as games.

One example of these games is Back in time with exciting explorers. Players complete small simple tasks while information and facts are being read out. For example, in the section about Neil Armstrong players are asked to click on a part of the rocket to separate it, whilst an explanation of why rockets do so is played out loud.

After extensively navigating through this website, I have discovered some pro and cons of using this style to meet the aim of this project. Bitesize provides a wide range of content

from many subjects, each of which are relevant to the UK's school curriculum. This method of teaching is effective for learning at home, and at school. Most importantly, the contents of this website is provided by teaching professionals, therefore all the information is relevant to what students learn in schools. However, in terms of design and game mechanics, the content of Bitesize games is repetitive, as all the games follow a similar structure of being a quiz-like game or an interactive story. The methods used are almost too simple, even for the young target audience, so motivation and interest may easily be lost. Again, in the context of creating an educational experience by integrating intrinsic motivation, Bitesize games are too focused on learning and not enough on entertainment. However, in any other context, this isn't an issue, and is a great learning resource.

Kerbal Space Program

Figure 11 - Kerbal Space Program

This rocket simulation game focuses on a space program for an alien race called the Kerbals. This game teaches children about physics, the solar system, mathematics and basic aerospace engineering. KSP allows its players to manage a space agency and to conduct spaceflight missions in a fictional solar system. It helps its users to develop a thorough understanding of common spaceflight terms and procedures.

In a user study, participants played KSP for two weeks to test for the predicted learning effects. Oberdörfer and Latoschik (2019) summaries the finding in their article:

"The study revealed that KSP effectively educates players in orbital mechanics and even motivates them to search for additional information to successfully and efficiently play the game. When used as an educational tool, KSP achieves a similar learning outcome to a traditional paper-based learning method. While playing the game, the participants reported a high motivation to tackle the assignments. In this way, knowledge learning using KSP yields a high learning quality. KSP allows for a visualization of spaceflight relevant problems that would otherwise be hard to demonstrate due to the high costs and risks of a real world demonstration. Thus, KSP can be recommended as a supplementary educational tool for grounding aerospace courses."

Conclusion

Throughout all the research conducted for coming up with a concept, I've leaned towards creating a game that focuses on a specific topic. Civilization is a game that does this really well, however, to tailor towards a younger audience, I want to create a game that is even more narrowed down on a topic, which is something BBC Bitesize does well. Civilization and Kerbal Space Program both incorporate the integration of intrinsic motivation for learning, through providing an immersive gameplay experience. This encourages further learning outside of the game, which is what I aim for in my project.

Learning Domain

For this project, I needed to select a topic to base the educational experience on. To do this, I had looked at the national KS2 curriculum. The findings from secondary research show that puzzle and adventure were the two most popular game genres amongst the target audience.

This helped narrow down what topic to choose, as it would need to suit these requirements. From the information in the affinity map (Figure 3), exploration was a common theme that appeared in the list of popular games amongst children. This list of popular games also showed that cartoony, stylized graphics made an appearance more than realistic graphics. Using all this information, I decided to use the topic of Earth and Space in my game, as it allows for using all the characteristics mentioned. This topic also opens up doors to incorporate some real life physics in the gameplay.

The national KS2 curriculum for the topic of Earth and Space defines these requirements:

Pupils should be taught to:

- describe the movement of the Earth, and other planets, relative to the Sun in the solar system
- describe the movement of the Moon relative to the Earth
- describe the Sun, Earth and Moon as approximately spherical bodies
- use the idea of the Earth's rotation to explain day and night and the apparent movement of the sun across the sky

In addition, there are some non-statutory requirements:

- Pupils should be introduced to a model of the Sun and Earth that enables them to explain day and night.
- Pupils should learn that the Sun is a star at the centre of our solar system and that it has eight planets: Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus and Neptune (Pluto was reclassified as a 'dwarf planet' in 2006).
- They should understand that a moon is a celestial body that orbits a planet (Earth has one moon; Jupiter has four large moons and numerous smaller ones).
- Pupils should find out about the way that ideas about the solar system have developed, understanding how the geocentric model of the solar system gave way to the heliocentric model by considering the work of scientists such as Ptolemy, Alhazen and Copernicus.

Using the curriculum as a guide, and teaching resources from BBC Bitesize and Ducksters, I was able to find educational content to add to the game. I have split up the content into sections, such as gravity, the sun and rock planets. Throughout different points of the map, the facts will appear on the users UI. For example, when the players leaves the crater these facts about rock planets will appear:

Rock planets - These are made of rocks and metals. The four rocky planets are Mercury, Venus, Earth and Mars.

(See Appendix A for the full table of information)

Design Statement

Identification of a need

In the study conducted by Rocha et al (2018), 60.6% of teachers use digital games at least once a month, which proves that they have positive effects. Out of the 30.9% of respondent teachers who don't or rarely use these games, one of the common reasons why was the lack of good games. In a survey conducted by Games and Learning Publishing Council (2014), 80% of respondents wished it was easier to find games that align to curriculum standards. Using

the data gathered, we are also able to understand what types of games primary school children lean towards, and we can use this information to create a product that is loved by students whilst meeting curriculum standards.

Design requirements

In order to create a product that fits the needs of the users, a list of essential design requirements is necessary. These design requirements have been created with the audiences needs as the main priority. The game must:

- Provide relevant information about Earth & Space, suitable for children in Key Stage 2.
- Have a genre of Adventure (popular among the target audience).
- Provide a compelling narrative. This is one of the methods of integrating intrinsicn motivation to play they game. The story of the game is important to attract and maintain interest.
- Be accessible on any desktop computer, as it is a common device in both schools and homes.

Final concept

For this project, I will be designing and implementing a game using Unity 3D. The game will be tailored to children in Key Stage 2, providing players an engaging, interactive way of receiving information. The subject will be Earth and Space as this is on the national curriculum. The player has crash landed on unknown planet but need to make their way back to Earth. They need to make their way across the map to another rocket ship that was left there from a previous mission. The ship has been there a while and needs restoring, so as the player makes their way there, they'll need to gather some resources, e.g. metals. They will also need to collect food for the journey home.

However, there will be some obstacles that will slow them down, such as a maze or fog. During the game, some facts will appear on screen as the player explores around. This is where the educational content is. For example, when approaching some fog, the UI will display a fact about gas planets. There will also be moments in this experience where players will need to complete a minigame to move on to the next part. These will be 2D games that use components such as physics and gravity to follow the theme of Earth and Space.

The design style will be cartoon which essentially includes both low poly and hand-painted options (see the mood board for examples of this style). This style is commonly used in some of the popular games amongst children, possible due to the distinctive features such as colourfulness, relative simplicity, exaggeration of accents and non-standard proportions.

Development Stage

Development Process

For this project, I used the Incremental Development Model. This methodology emphasizes the virtue of taking small steps toward the goal (Spencer, 2019). This method was very helpful as this project consisted of many different components, such as research, design, engineering and evaluating. With the incremental model, I was able to incorporate prototyping into the development, which was necessary in getting an understanding of what can be accomplished in time. This design model uses a planning and implementation that is cycled after rounds of user testing.

The initial planning phase consisted of figuring what features the game will have. Using the requirements and the information from the secondary data I was able to determine a storyboard (Figure 12). This shows a basic overview of the mechanics of the game.

Storyboard

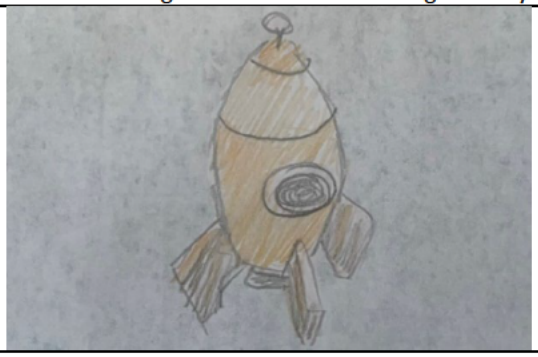
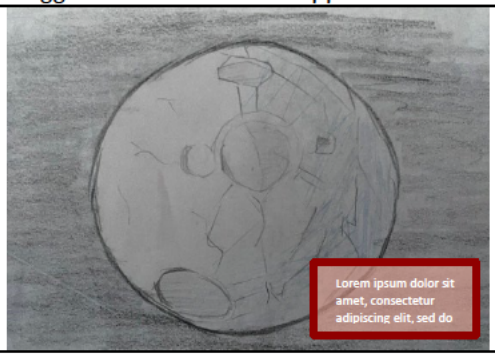
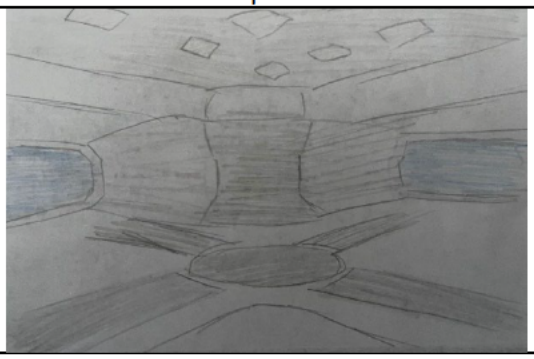
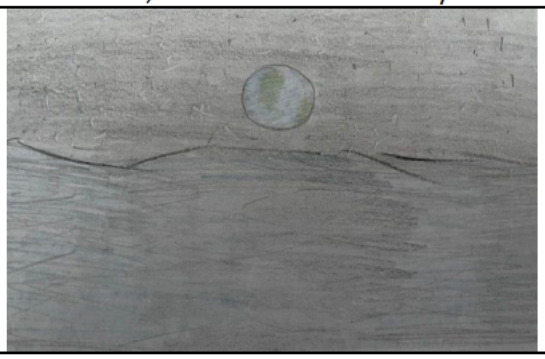
	
Player crash lands on planet, destroying the rocket. Told that there's another rocket on the planet, it needs restoring. Collect resources along the way.	Player makes way along the map. On the journey there will be some obstacles and collectable items. Triggers make the facts to appear on the UI.
	
Once all items are collected and the player reaches the rocket ship, an animation plays of them leaving the planet.	The rocket lands on earth's moon base (animation of this plays). The ship needs to refuel. This may take a few minutes, have a look around while you wait.
	
Whilst waiting player explores the moon base, where more facts will appear in different areas.	Once fuelled up, player can leave and go back to earth.

Figure 12

For the design, I created a mood board (Figure 13) of how I planned the world design to look like. As mentioned in the final concept, the game will follow a cartoony style and design. The game will have elements that are not real, which opens up doors to experiment with the assets and colours used in the world, as they aren't restricted to a realistic design. I then brainstormed some features to add to the narrative (Figure 14), in order to push the genre of adventure. During this brainstorm, I was able to think of different elements to add to the game to increase entertainment whilst adding educational content.

Mood board

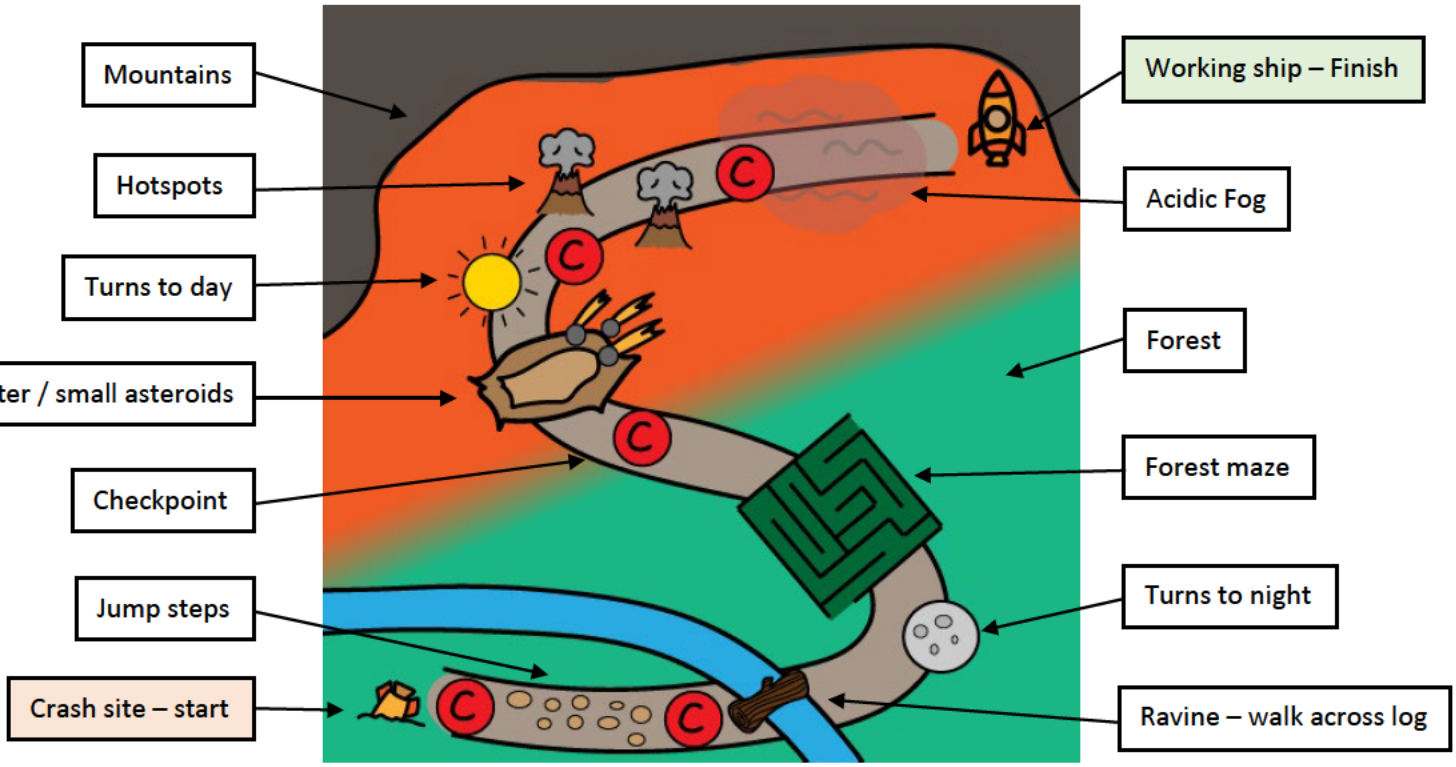
Figure 13

Obstacles & *fact*	Collectables	Minigames
Jump steps – *gravity* Ravine - Asteroids – *asteroids* Acidic fog – *gas planets* Volcano - Maze - Cliff - Black hole – *black hole* Crater – *rock planets*	Metals to restore the ship Food – fruits from plants	Quiz Pipe puzzle Password to enter ship Asteroid shooter

Figure 14

The final step of the initial planning was to create map designs (Figure 15) of how each scene would look like. I had planned for the game to have a range of features and mechanics, such as obstacles, animations and colliders, therefore it was crucial that I had planned out what goes where beforehand.

Map Designs



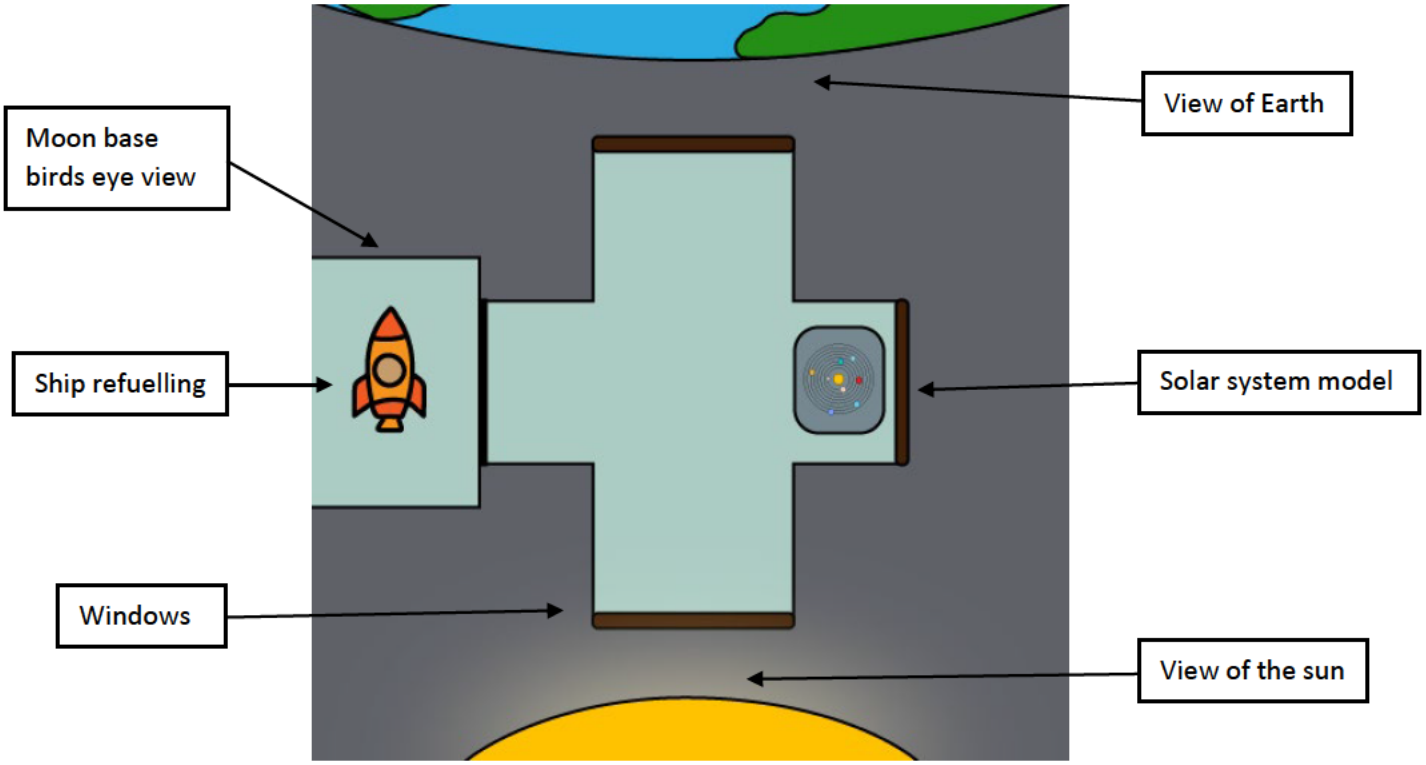


Figure 15

Prototyping

In the development phase, I started with a very basic prototype (without much graphics), to ensure that it works efficiently before adding more complicated features.

A key part of this development was to start off with prototyping the obstacles that would be included in the game. As seen in the game narrative brainstorm (Figure 14), I had many ideas for obstacles to include in the map. Before going ahead with design and implementing these obstacles, I created prototypes of each on, with the focus being on the code. This was so I could figure out what would work, before spending time on the design of them.

During this process, I found that there were some ideas that I initially had which couldnt be implemented in time, such as a black hole obstacle. Therefore I moved on to creating the visuals and assets instead, as I could always come back to the unfinished obstacles afterwards, if I had time.

Sketches

This game included a large number of UI elements. There are multiple scenes that each require multiple UI canvases. To ensure the process of creating these elements is as smooth as possible, I created some sketches to get an understanding of how they might look, before spending time creating them in unity.

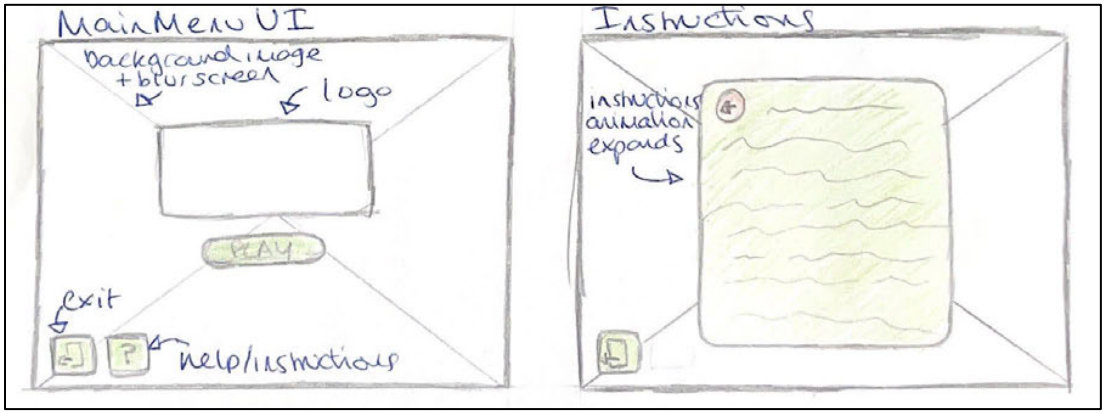


Figure 16 - UI sketches

Figure 16 demonstrates how the the interface for the Main Menu would roughly look (see Appendix B for the UI sketches). It shows the placement of elements and colours that will be used. Although, throughout the development process, I added more features to the game and therefore more UI elements, I was able to reference back to these sketches as inspiration, and followed the same theme.

The next part of this development process was to implement these designs and prototype into a build. This version then undertook user testing with participants, against the requirements. Using this feedback, I was then able to go through the development cycle again, adding more features to improve the game.

Description of Experience

Main Menu

When the game initially loads, players are welcomed to a main menu page. Here players can press a button that opens a window with the instructions on it (Figure 17). This gives a brief description of the objective and also displays game controls. As the target audience if young, it's important that they understand what to do beforehand, and aren't thrown into the game confused. There is also a button that opens up a window displaying facts and information about earth and space (Figure 18). This is broken up into categories, such as the sun and gravity. It's important that players are able to learn as much as possible, so these facts are made to be easily accessible.

Figure 17 - Instructions

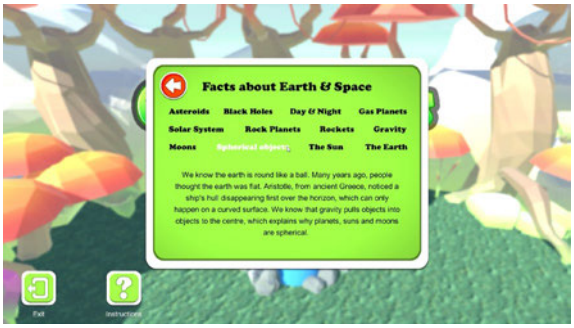


Figure 18 - Facts

Alien planet

When the game starts, an animation plays of a ship crashing onto a planet, followed by cut scenes of the world and a voice over explaining the objective of the game in case players didn't read the instructions at the start, and to give a visual understanding of what to do.

As players traverse the map, they will come across many obstacles to tackle, such as asteroids and a ravine. Around each obstacle a fact will appear on the screen, that relates to the obstacles they are tacking. For example, at the jump steps obstacles, a fact about gravity will pop up. This helps the player better understand the fact, as an example of the it is shown. This may also help remember the fact as they associate it to an obstacle. The players are able to pause the game, and on the pause screen, the controls are displayed along with a button to open the facts window. Facts that pop up during the game are a shortened version, so that there isn't too much information to take in at once. Players are able to pause the game and read the extended version if they would like to.

In order to leave the planet, players must collect all the metals and fruits first, that are scattered around the map. This is to add to the narrative of a ship crash, as naturally in this situation you would need to gather resources.

There is a point in the map where the terrain changes from a jungle to a desert. This was implemented so that the facts about asteroids and rock planets match the environment. Again, so that the players associate the facts with the obstacles to better remember them.

When the player reaches the ship, they must have all the resources before restoring it. After the ship has been restored, a quiz pops up on screen and it must be completed before boarding the ship. This acts as a password to enter the ship. This was added to ensure that the players are taking in the information and using it.

Moon base

After leaving the alien planet, the player lands on Earth's moon base, in order to refuel the ship. Similar to the planet, a voice over explains to the player what they must do as a camera pans around the base. The moon base was added to the game to incorporate a more realistic setting. This is also included so that the facts about our solar system and earth can be shown at an area that matches the environment. For example, a fact about the solar system pops up when the player approaches a model of the solar system in the base.

In order to refuel the ship, the player must complete a pipe puzzle. This has been added because the research from the Joan Ganz Cooney Centre (2016) showed that puzzles where the most popular game genre amongst young people. So, incorporating this adds a level of entertainment for players. After this is complete, a 30 second countdown begins until the refuel is complete. This is to ensure that players spend time looking around and reading the facts. Finally, players can enter the ship and animation plays of it returning to Earth.

Description of Technical Implementations

World design / 3D Models

The design of the game follows a sci-fi theme, as its set on an alien planet and a moon base. For the design of the alien planet, I wanted to use a mix of colours and assets, therefore I decided to use two types of terrain. The first section is a colourful forest (Figure 2), whereas the second half is the opposite, a rocky and lifeless desert. As this is an educational game, I didn't want this to be too unrealistic, so I decided against including any aliens or signs of life. The obstacles in the game were designed to be from natural causes and without influence from humans, e.g. the ravine with a fallen tree trunk. I wanted to tailor the world design to correspond with whatever fact appeared on screen. For example, I had added a crater as this would be a good area to spawn a fact about rock planets.

I decided to add an extra scene into that game, which is the moon base (Figure 3). The game would have worked without this, but I wanted to a more realistic area to include facts about our solar system, the earth and the moon. The alien planet scene is not based on an existing planet, so in order to have some more realism, I created the moon base.

My main focus in this project was the coding and engineering of game, therefore I downloaded all of the models from the Unity store. The majority of the 3D assets are from the Alien Planets Vol.3 (for the alien planet scene) and the Modular Sci-Fi Zone Pack (for the moon base scene). These both followed the stylized sci-fi look that I was looking for and were easy to customise.

Player

The design and functionality of the player is a very important aspect of the game. I decided to make the player have a third person perspective in order to add animations to the character for an extra level of entertainment for the children. Also, being able to see exactly where the player is standing and moving makes controlling the character easier for young players. In order to prevent the player from obstructing the view of the map, I moved the camera behind the player and also increased the field of view to have a wider perspective.

I downloaded the player model from the Cosmos Pack from Unity asset store. This pack came with some character animations built in, such as running, jumping, grabbing and dying. I used the jumping animation, modified it to look like the player was falling and added this to

animator. This pack also included a movement script. However, I changed a lot of this to include the functionality that was needed for the game. For example, I used a raycast to detect if the player is grounded, so that they can only jump if so.

```
if (Input.GetKeyDown(KeyCode.Space) && IsGrounded()) // if the space bar is pressed, and the player is grounded
{
    if (anim != null)    // checks for an animation
    {
        anim.Play("jumping");    // plays jumping animation
        player.AddForce(new Vector3(0, jumpHeight, 0), ForceMode.Impulse); // adds an upward force to the player
        jumpSound.Play(); // jump sound plays
    }
}
```

Figure 19 - Code to detect is player is grounded in order to jump

Obstacles

Checkpoints

As there are numerous obstacles in the game, I've implemented various checkpoints through the map, using code adapted from Blackthornprod (2019). To create the checkpoints for the game, I used a number of box colliders, with a script attached to it. The gamemaster, playerPos (attached to player) and checkpoints script work together so when a player enters the collider, the lastcheckpoint value is set to the position of the checkpoint. Then if the players position is less than -4f (meaning that they fell off the map) their position will change to the last checkpoint that they passed. This is used for the jump steps, ravine, and for the moon base.

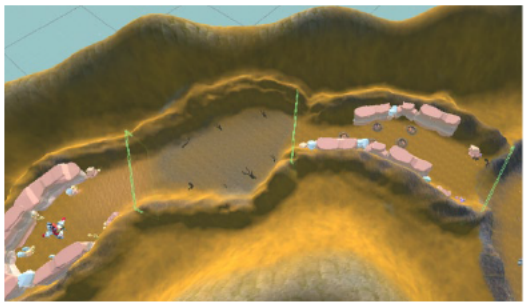


Figure 20 - Checkpoint colliders

Maze

The maze consists of trees and rocks blocking the path, with only one way to get through. This area uses a mix of jungle and desert assets as it's the point in the map where the two terrains meet. To make this slightly easier, I have added a box collider around the full maze, so when the player enters the maze, a mini map will appear on the UI, with the correct path highlighted. I added this feature after some participants in the user testing struggled with getting through the maze. When the player exits the collider, the map disappears.

Figure 21 - Maze

Asteroids

There were multiple considerations to make when creating the asteroids; spawning, moving and colliding. To prevent having too many GameObjects in the scene, I coded the asteroids to spawn when the player is within a certain distance, and to destroy them after it has hit the ground. Using InvokeRepeating, the asteroid prefab was instantiated every x second, only when the player was within the set distance. I made the distance and spawn time public variables in order to customise these values for each spawn point. I attached a separate movement script, so that the spawn point doesn't move, just the asteroids. The asteroids moved using AddForce, as they had a rigidbody attached to them. I wanted to incorporate

some realistic features to these asteroids, so I added a dust explosion particle to play when the asteroid hits the terrain. Using code from Sykoo (2019), I added an explosion force to impact all the rigidbodies in the set distance from the explosion. If the player was directly hit by an asteroid, they would get sent back to the last checkpoint. In order to destroy the asteroids on impact, I had to attach a script to the terrain, instead of the asteroid, in order to allow for the dust particle to play, after the asteroid was destroyed.

Volcanic Hot Springs

When the player walks over one of the hot springs, it triggers an eruption of steam and shoots the player up in the air. The player is jolted up using the AddForce method that it used for rigidbodies. The collider detects the player using the Player tag, and this activates the force and visual of the hot spring. The visuals were created using unity particle pack that was modified to look like a hot spring. This also triggers the falling animation to the player, so that it looks more natural, when they are in the air.

Acidic Fog

To create the visuals of an acid fog, I used the dust storm prefab from the Unity Particle Pack and modified it to look like a green fog. This plays throughout the game. When the player enters the trigger zone, the players lifeline begins to decrease. This is shown by a slider on the UI. When the lifeline reaches 0, the player death animation plays and then the player is taken back to the last checkpoint. The lifeline slider only appears when the player is in the gas zone. If the player leaves and then re-enters the gas zone, the lifeline will resume from where it left off.

Collectables

As part of the narrative of this game, the player needs to restore the old spaceship that has been left by previous explorers. To do this, the player must gather all the metals during their journey. They must also collect food for the journey. This was done using colliders and UI elements. Each metal and fruit has a collider attached to it that is larger than the model. When the player is near it, text on the UI appears with instructions to press G to collect. I have also attached a glow particle and 3D sound to the collectables, so the players can clearly identify them. When the player presses G, a grabbing animation plays and the metal or fruit count goes up by 1, as seen in the UI (Figure 22). Players cannot restore the ship without collecting all the resources first.

Figure 22 - Collectables

Camera Animations

At the start of the Alien Planet and Moon Base, a sequence of camera animations play that shows the surrounding areas, as an audio plays. To do this, I set the players camera as inactive and then one by one set each of these panoramic cameras on and off, as there could only be one audio listener active at a time. For the Alien Planet start sequence, I added each camera using an array. Then using an IEnumerator coroutine, I set them as active one by one, which displayed the moving animation, and then ended it with having the player as active. I used a similar method for the moon base, but decided to do something different, so

I only used one camera and created a longer animation of it moving around the scene. This overview camera shot of the terrain allows for the players to get an understanding of what they need to do. I also purposely timed the camera to show the metal and ship at exact time they are mentioned in the audio.

2D Minigames

I wanted to add extra features to the game to prevent the children becoming bored. I decided to incorporate 2D minigames to the games. In the study conducted by the Joan Ganz Cooney Centre (2016), it showed that puzzles are the most popular game genre amongst children and adults, so this would a great feature to include. I decided to create a pipe puzzle game, where the pipes rotate on mouse click in order to connect them (Figure 24). This game is added to the moon base and needs to be completed in order to refuel the ship. To create a 2D game in a 3D scene, I added a static camera that faces the sprite images of the pipes. These components are only active when the start button is pressed, so they cannot be seen in the scene otherwise. I used and adapted code from Zotoy (2018) to do this. The code below checks for the rotation position of each tile in order to determine if they have won.

```
void Update()
{
    if (pictures[0].rotation.z == 0 && // if all image rotations are 0
        pictures[1].rotation.z == 0 &&
        pictures[2].rotation.z == 0 &&
        pictures[3].rotation.z == 0 &&
        pictures[4].rotation.z == 0 &&
        pictures[5].rotation.z == 0 &&
        pictures[6].rotation.z == 0 &&
        pictures[7].rotation.z == 0 &&
        pictures[8].rotation.z == 0)
    {
        winUI.SetActive(true);          // win ui is active
```

Figure 23 - checks image rotations to detect win

However, using this method caused an issue. For the pipes that are straight, they can be turned to 180 degrees and the puzzle is complete. However, the code does not register. I had tried to fix this but could find a solution. Therefore, I set these pipes to be at the correct position when the puzzle is loaded, so that players might not try and rotate them.

After conducting user testing, a point was made to include a feature where players would need to use the information they have learnt somehow. With this feedback, I added a short quiz section in the Alien Planet (Figure 25). In order to board the ship, player must answer three questions correctly. The questions were based on the information given throughout the game. This was created using UI buttons. If they pressed an incorrect answer, the button would turn red, but nothing else would happen. If they answered correctly, button turns green and after 2 seconds the next question loads. After the third question, a coroutine starts that shows an animation if the ship taking off, and the next scene loads.

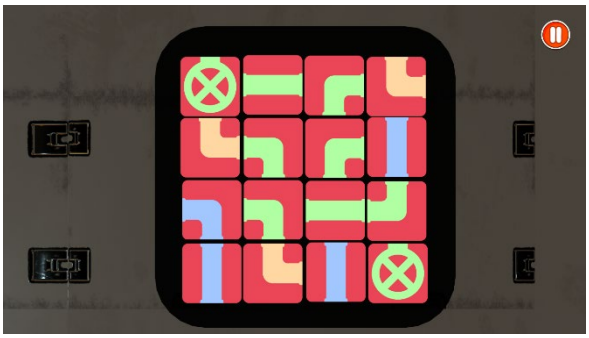


Figure 24 - Pipe puzzle

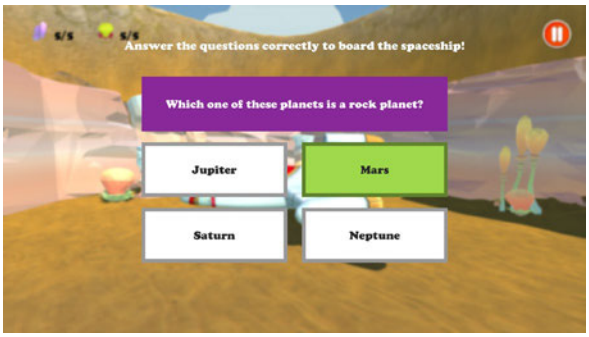


Figure 25 – Quiz

Collisions

There are many collisions in this game to carry out different functions. As mentioned earlier these are used often for the obstacles and checkpoints. A main feature of this game is to incorporate educational content. This is done by having fact appear on screen, depending on where on the map the player is. To do this, I added empty game objects throughout the map with box colliders attached to it. These have been strategically placed in areas that correspond to the fact that appears. Each of these colliders have the script factsUI attached to it. In order to input a different fact for each gameobject, there are public Texts saved as newTitle and newFact, where I can input the text through the inspector for each gameobject. The text that appears on the UI are set as myTitle and myFact. Whenever the player enters the colliders, the text that is visible is changed to be the text that was input into the inspector. After a number of seconds, this gets reset, and this is repeated for every fact trigger.

In order to have a suitable place to trigger the facts about the day and night cycle, I used the directional light to mimic this cycle. I added a day trigger and night trigger to play an animation that changes the rotation of the directional light, making it darker and lighter again.

Audio

There are many audios used throughout this game. Including various audios is one way to improve user experience, so it was important to add these. Some of these where fairly easy to implement, by adding an AudioSource to a GameObject and then calling the audio, when necessary, e.g. when the player falls into the eater, a water splash audio is called. However, there were many GameObjects that required multiple audios attached to them. To ensure that the correct audios are called, I defined each AudioSource using arrays. Below is an example of this method used to play audios for the spaceship. This method organises the audios into the array based on the order they appear in the inspector. This allows for multiple audios to be called in one script and from one GameObject.

Declare the audio variables.

```
private AudioSource[] mysounds;
private AudioSource restoreAudio;
private AudioSource takeoffAudio;
```

Define each audio in array.

```
mysounds = GetComponents<AudioSource>();
restoreAudio = mysounds[0];
takeoffAudio = mysounds[1];
```

Figure 26 - Audio array example

UI

The UI is a crucial design element of this game. There are a number of UI canvases in each scene to make the game as interactive as possible. Some of these have been mentioned earlier such as the factsUI. This appears in both the Alien Planet scene and the Moon Base scene. When the player enters a collider, a coroutine is started which consists of an animation playing and the text being set to the fact. After a short time delay, a closing animation plays and the text is set to blank.

Main Menu UI

The main menu scene doesn't include any 3D elements. This scene just includes a canvas for the UI elements. This menu consists of the game logo in the centre, with a large play button underneath. In the bottom left corner, there are three buttons. Each of these three buttons are labelled and have an icon to show what they are. The first is an exit button. The second button opens an Earth and Space facts window. Here, users can click through the different sections and read some information about Earth and space. I decided to add the facts here as I wanted this information to be easily accessible. This section also includes some facts that are not in the game, due to a lack of places to place them. E.g. the black hole fact is not in the game, as I couldn't engineer a black hole obstacle in time. The third button opens up the Instructions window. This gives a brief description of the objective and also displays game controls. I think it's important that players have a full understanding of the game controls before they start playing, which is why I placed this here. When both the facts button and instruction button is pressed, an animation of the screen expanding plays, with a swoosh audio, to add another level of movement.

The Alien Planet and Moon Base scene have a pause function. When the pause button is pressed, the game UI switches to the pauseUI. This includes a blurred screen, so players can slightly see the game in the background. This UI has a resume button, main menu button and a button that opens the facts window (similar to the Main Menu). There's is also an image of the player controls in case they need a refresher. In order to truly pause the game, when the pause button is pressed, the Time.timeScale is set to 0. This pauses any movements that occur in the scene, so if an animation was playing, or an object was moving they are paused in time. The time scale is set to 1 again when the resume button is pressed.

Alien Planet UI

The Alien Planet scene consists of two main UI canvases, the gameUI and PauseUI. To switch between them both I created a PauseUIControler script. The gameUI includes the pause button, a mini map for the maze and the fact UI elements. This also includes a slider for the acidic fog obstacle. The players lifeline when moving through the fog is stored using a float variable. This same float is then assigned to equal the width of the slider in the UI. So, as the lifeline value decreases, so does the width of the slider, allowing the player to visually see their lifeline. This slider is only visible when the player is in the gas zone.

The collectable items UI is also included in the gameUI and is active throughout the whole scene. The number of items collected is stored as an integer and the UI text value is set to equal the integer. This allows the player to see how many they have collected on the screen. I also added a small image of the collectable item next to this text, as user testing has shown that some people were unsure of what they were looking for.

In addition to the gameUI and pauseUI, this scene includes the quizUI (Figure 25). To create this quiz, each question has four buttons, and they are all set to have an empty parent object. Setting these parents as active and inactive is how the next question would appear. This code is placed in the ShipControllerScript, as it is set active as part of the restoring ship coroutine. After the quiz questions have all been answered correctly. The ships coroutine resumes.

```
IEnumerator ShipCoroutine()
{
    player.SetActive(false);    // player is inactive
    shipCam.SetActive(true);    // static camera showing ship is active
    pressR.SetActive(false);    // instruction to press R is inactive

    yield return new WaitForSeconds(2);     // 2 second pause

    restoreVFX.Play();          // restoration particle system plays
    restoreAudio.Play();        // audio plays
    oldShip.SetActive(false);   // old ship inactive
    newShip.SetActive(true);    // new ship active

    yield return new WaitForSeconds(2);     // 2 second pause

    quizUI.SetActive(true);     // quiz ui is active
    q2.SetActive(false);        // only q1 is visible at first
    q3.SetActive(false);

}
```

Figure 27 - Coroutine that activates quiz

Moon Base UI

Similar to the Alien Planet scene, the moon base has a gameUI, however this only consists of the facts UI elements and a pause button. Instead, this scene has two UI canvases for the pipe puzzle, a start UI and win UI. The start UI is fairly simple and contains of some text instruction the user to start to fuel the ship, and a start button. This appears when the player enters the collider, however this has a condition that checks to see if the player hasn't already completed the puzzle. Once the start button is pressed, the player is set as inactive and the puzzle GameObject and camera is active. The puzzle itself is not created as a UI canvas as I found it was simpler to code each tile as a 3D GameObject rather than UI images and buttons (Figure 24).

After the player has competed this puzzle, the puzzle is set as inactive, and the win UI is set as active. This includes a large text that says "Completed!" and is on screen for a few seconds. In the top left corner, a countdown appears showing how long until the ship is finished refuelling. I added a time to encourage players to look around the scene while they wait. This way there's a higher chance of players reading the facts and not just ignoring those areas completely. Once the countdown reaches zero, the player is able to access the ship.

The final UI of the game is active once the player reaches the ship. After an animation of the ship leaving the moon base plays, a black screen appears and the end credits play. This is an animation of UI text moving up the screen.

Lighting

The Alien Planet scene is set outdoors, so it uses directional light to lighten up the scene. This mimics how the sun gives out light and causes shadows. The directional light also has an animation attached to it create a sunrise and sunset. The skybox in this scene is designed to

look like daytime, so this brightens up with scene quite well, even after the sunset. I didn't add any artificial light, as I wanted the scene to be as natural as possible. However, this meant that the build quality needed to be set as high, in order to preserve the light. Unfortunately, this lowered the games framerate slightly. I also baked the lighting in the scene to ensure the build quality is the same as displayed in the editor.

The Moon Base scene is primarily indoors, and the skybox is very dark. The little atmosphere on the moon means they sky look like empty space, so this needed to be replicated in the scene. Unfortunately, because of this, the scene is quite dark. I added some wall lights with area lights attached to them to brighten up the space. I also attached an emissive material to the ceiling to add some extra light. The moon base is still quite dark, but I decided to keep it this way as I believe this seems quite realistic to my understanding of what a moon base would look like.

AI

I considered adding AI elements to the game like including aliens that attack the player or move around the planet. However, I felt that it didn't fit the context of the game. It's an obstacle game, not a combat game. Also, I aimed for the made up planet to still have as much realism as possible.

Ethics

This project is aimed towards creating a piece of educational content for young children. This causes some ethical concerns, as working with children requires approval from the ethics board. To gather data about children's gaming habits in schools and at home, I used secondary data from published studies. I believed that I had found all the information that I needed this way and didn't feel as if I needed to conduct any of my own studies. As a result, the design and research stage of this project, didn't require any ethical approval.

It was very important that I tested this product with human participants, to ensure the success of this project. To keep this project as ethical as possible, all user testing was conducted with adults. I sought out parents and teachers who are around young children. Their perspectives are very important, as the target audience are too young to fully understand the aims and requirements of this project. I also sought out gaming experts to give feedback on the narrative, design and mechanics of the game. In this particular project, the design and technical quality of the game equally as important and the educational content, as the aim is to create a product that intrinsically motivates children to play the game and search for additional information.

Each participant read the information sheet (Appendix D), which contains all the information on the purpose of the study, and how the data will be used, stored and destroyed. They then signed an informed consent form (Appendix E), before participating in the testing. This user testing was anonymous, therefore there were not any questions asked that could identify the participants.

Evaluation

User Testing

Overview

A round of user testing was conducted to test the project against the aims and requirements. For the test, the participants were given access to a google drive that contained the unity build and a link to a google form. They were asked to complete the tasks without the presence of a moderator. The data was collected through a questionnaire, using Google Forms.

Subjects and apparatus

There were 4 participants for the testing of the game. The sample size is rather small, as there were restrictions to how each of these tests could be conducted, e.g., remote testing. This sample consists of a teacher, 2 parents and a gamer. As this was a qualitative test, the small sample size was not an issue.

Procedure

Each participant was sent a link to a Google Drive that contained all the documents needed to conduct the test. The first file, named “Read Me”, is a text document that contains some instructions in the order they need to be completed (Appendix C), such as information sheets (Appendix D) and consent forms (Appendix E). Once that was completed, they could open the questionnaire (Appendix F) and begin the testing. The questionnaire was split into two sections; tasks, and questions. All the questions would receive qualitative data. This questionnaire was purposely conducted in this way, as the likelihood of the sample size being small was considered. Therefore, there would not have been enough participants to generate reliable findings from quantitative data. A lot of the questions are opinion based, such as “Describe your opinions on the 2D user interface design of the game”. A standalone build was included added to the drive, so the users were able to run the program. Once they had played the game and worked through the form, they were done.

Findings

(Appendix G)

- The design of the UI received a fairly positive reaction, with particular fondness to the colours and theme. However, a common result occurred, with some text not being noticeable enough, especially the collectables. It was brought to attention that there were some minor spelling and grammar errors in the facts. The buttons on this section needed to be clearer. The controls were missing the space bar to jump. Half of the respondents stated that some buttons needed labelling, so their functions are clearer.
- Overall, the world design received positive feedback. The results show that respondents liked the use of natural elements (such as rocks and trees) and multiple sections (forest and desert). Some participants who weren’t particularly used to playing games stated that some obstacles were difficult; the jump steps needed to be bigger, and the maze was a little difficult to navigate. Further improvements need to be made to the world design such as adding more design elements or collectables.
- Each participant liked that the flow of the narrative. Some specific positives were the use of collectable items, audios and having a moon base. One respondent felt that there could be more facts used.

- 100% of participants agreed that the game mixed the focus on education with entertainment effectively. However, it was noted that the attention may be more focused on entertainment.
- 100% of participants though the game effectively incorporates intrinsic motivation to play the game. They all seemed to have a similar response to this question of the game not pushing information on to the children, but they liked that it's there. One participant stated, "I can see my child wanting to play this for fun, and then if they learn a little something, that's a bonus".
- Some improvements for the game controls were noted. These included to lower sensitivity of the turning and the jumping was a little difficult. However, the controls were easy to understand.
- Some bugs and issues were pointed out. The audio doesn't pause with the game, causing it to be out of sync at times. The maze had issues of players being able to push through walls.
- Each participant had a different answer when asked if there were any positives that stood out. This included: music fits well with the theme, the animations were impressive, the game was as realistic as possible, and the length of the game was a nice amount.

The aim of this project was to provide an interactive and engaging educational experience for young children, by integrating intrinsic motivation. When asked about the use of entertainment and educational content, the responses are generally positives and show that this has been done successfully. However, there is always room for improvement.

Improvements

Using the data gathered in user testing, I had undergone another round of development to improve the game, in order to meets the aims and requirements as much as possible.

I had received a lot of positive and negative feedback about the UI elements of the. This is likely due to the UI being a very large and important part of the game. I had implemented many small changes, such as fixing spelling issues, increasing text size and labelling buttons. One participant mentioned that when reading the facts in the Main Menu, there needed to be a way to see what fact you were on, therefore I changed the buttons to be white when selected. I also decided to add this whole section to the pauseUI in game. This is so players when players read a fact that's appeared, they can access more information by pausing the game. Doing this may increase the amount of information players are taking in and learning.

One participant suggested that if there was a way to use the information learnt in the game, it would benefit the player. With this in mind, I added another mini game to the Alien Planet. In the initial planning phases, I thought about adding a quiz to the game, to test the players knowledge, so this would be a great way to use the information learnt in the game.

I fixed small game bugs such as pausing the audio with the game, looping the background audio, and adding colliders to the maze. I also spent some time trying to reduce the lag in the game and increasing the framerate. I did this by bringing forward box colliders around the map, so players can't go towards some of the assets, then removing mesh colliders from objects, such as trees and rocks. I also lowered the view of the players camera, by changing the clipping planes.

There were a couple of issues that arose with the players controls. I lowered the running speed, turn speed and jump height slightly. This means that the sensitivity of the controls are more suited to younger players. I was also made aware that the instructions didn't include that the player can jump by pressing the space bar, therefore I had added this.

There were a few suggestions made to make some of the obstacles easier. I found that some of the participant's struggled with them, so if adults are finding it difficult, then so would key stage 2 children. I made the jump steps larger and reduced the number of asteroids. For the maze, I lowered some of the walls and made the paths wider. This not only made the maze easier to navigate, but I didn't have the problem of the camera going through walls as much. I decided to incorporate a miniature map of the maze, the shows the correct pathway to take. This again, makes the game slightly easier and less frustrating to play.

Reflection

In order to determine the success of this project, the outcomes must be compared to the design requirements set at the start of the project. Setting these requirements is key in any project, so to do this effectively, I needed to gather as much research into educational games as possible. Most of the information needed was easily found through desk-based research. I wanted to find teachers perspectives and what types of games are popular among children, and I was able to find this information without having to conduct my own user research. However, primary data would have been useful to get a deep understanding of the game designs and mechanics children lean towards; however, this is not something children aged 6-12 are usually able to understand and articulate.

The main requirement of this project was to provide relevant information about the chosen topic, that is suitable to be taught to Key Stage 2 children. I believe I had done this successfully, as all the content was gathered from BBC Bitesize and Ducksters (two websites that are written by teachers for teachers). I also ensured to go through the national curriculum and include information for each topic mentioned. On the other hand, the methods of implementing this information could be improved. A lot of inspiration for this game was taken from the Kerbal Space Program, which is a game that uses real life mechanics and physics in the game. If I had more time, I would have found a way to incorporate some more physics in the mini games. This would have increased the use of intrinsic methods for learning. If I were to improve the game further, I would include a mini game that relates to each fact. For example, a minigame that demonstrates the effects of gravity.

In order to integrate the use of intrinsic motivation, I created the game to have a genre of adventure, which was shown to be popular amongst young people (Figure 8). The genre in combination of a strong game narrative would increase the entertainment the game brings. The results from user testing showed that each participant believed that the game had a strong narrative and successfully used integrated intrinsic motivation. I believe this was successful because of the use of collectables items and multiple environments. As the story of the game was strong, the fact that the game was created for educational purposes doesn't seem as obvious. Hopefully meaning that children play this game for entertainment purposes, and therefore learn information subconsciously.

Using the incremental design method for the development process proved to work well. It allowed me to plan the project in detail, then implement a prototype. This was repeated

until the final product was complete. However, this could have been improved massively if I had multiple rounds of testing between each cycle. This would have allowed me to notice some mistakes earlier on in the project. There could have also been a bigger focus on the design elements during the prototype stages. Getting feedback on the designs early on in the project would have saved a lot of time.

Overall, I am pleased with the outcome of the project. Although there are a few changes I would have personally made, the feedback from the user testing showed that the game meets the main aim of providing an interactive and engaging educational experience for young children, by integrating intrinsic motivation.

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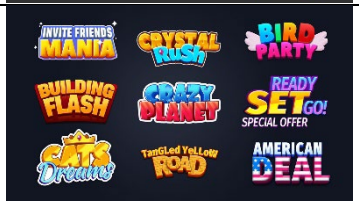
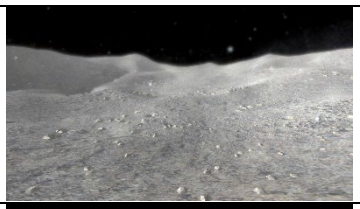
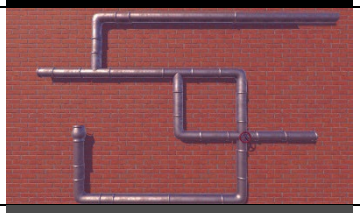
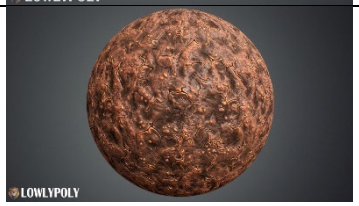
Copyright Table

Asset Description	**Image (if applicable)**	**Source**	**Licence/Permission**
Low-Poly Simple Nature Pack		https://assetstore.unity.com/packages/3d/environments/landscapes/low-poly-simple-nature-pack-162153#publisher	Standard Unity Asset Store EULA
Free Music Tracks For Games		https://assetstore.unity.com/packages/audio/music/free-music-tracks-for-games-156413#publisher	Standard Unity Asset Store EULA
2D Casual UI HD		https://assetstore.unity.com/packages/2d/gui/icons/2d-casual-ui-hd-82080	Standard Unity Asset Store EULA
20 Logo Templates with customizable PDS vectors		https://assetstore.unity.com/packages/2d/gui/icons/20-logo-templates-with-customizable-psd-vector-sources-174999#publisher	Standard Unity Asset Store EULA

Lunar Landscape 3D		https://assetstore.unity.com/packages/3d/environments/landscapes/lunar-landscape-3d-132614	Standard Unity Asset Store EULA
Planets of the Solar System 3D		https://assetstore.unity.com/packages/3d/environments/planets-of-the-solar-system-3d-90219#publisher	Standard Unity Asset Store EULA
Modular pipe pack		https://assetstore.unity.com/packages/3d/props/modular-pipes-pack-85778	Standard Unity Asset Store EULA
Galactic Heroes Cartoon Spaceship		https://assetstore.unity.com/packages/3d/galactic-heroes-cartoon-spaceship-70188#publisher	Standard Unity Asset Store EULA
Spaceship		https://assetstore.unity.com/packages/3d/props/industrial/spaceship-33345#publisher	Standard Unity Asset Store EULA
Stylized Textures Mini Set		https://assetstore.unity.com/packages/2d/textures-materials/nature/stylized-textures-mini-set-215522	Standard Unity Asset Store EULA
Modular Sci-fi Zone Pack		https://assetstore.unity.com/packages/3d/environments/sci-fi/modular-sci-fi-zone-pack-74204	Standard Unity Asset Store EULA
Alien Planets Vol.3		https://assetstore.unity.com/packages/3d/environments/sci-fi/alien-planets-vol-3-204886	Standard Unity Asset Store EULA

Cosmos Pack		https://assetstore.unity.com/packages/3d/characters/cosmos-pack-62180#description	Standard Unity Asset Store EULA
Unity Particle Pack		https://assetstore.unity.com/packages/essentials/tutorial-projects/unity-particle-pack-127325#publisher	Standard Unity Asset Store EULA
Stylized Grass Texture		https://assetstore.unity.com/packages/2d/textures-materials/glass/stylized-grass-texture-153153#publisher	Standard Unity Asset Store EULA
Stylized Terrain Texture		https://assetstore.unity.com/packages/2d/textures-materials/floors/stylized-terrain-texture-153469	Standard Unity Asset Store EULA
All Audio		https://mixkit.co/	Stock Music Free License
Cooper Black Regular – Font		https://fontsgeek.com/fonts/Cooper-Black-Regular	Free License

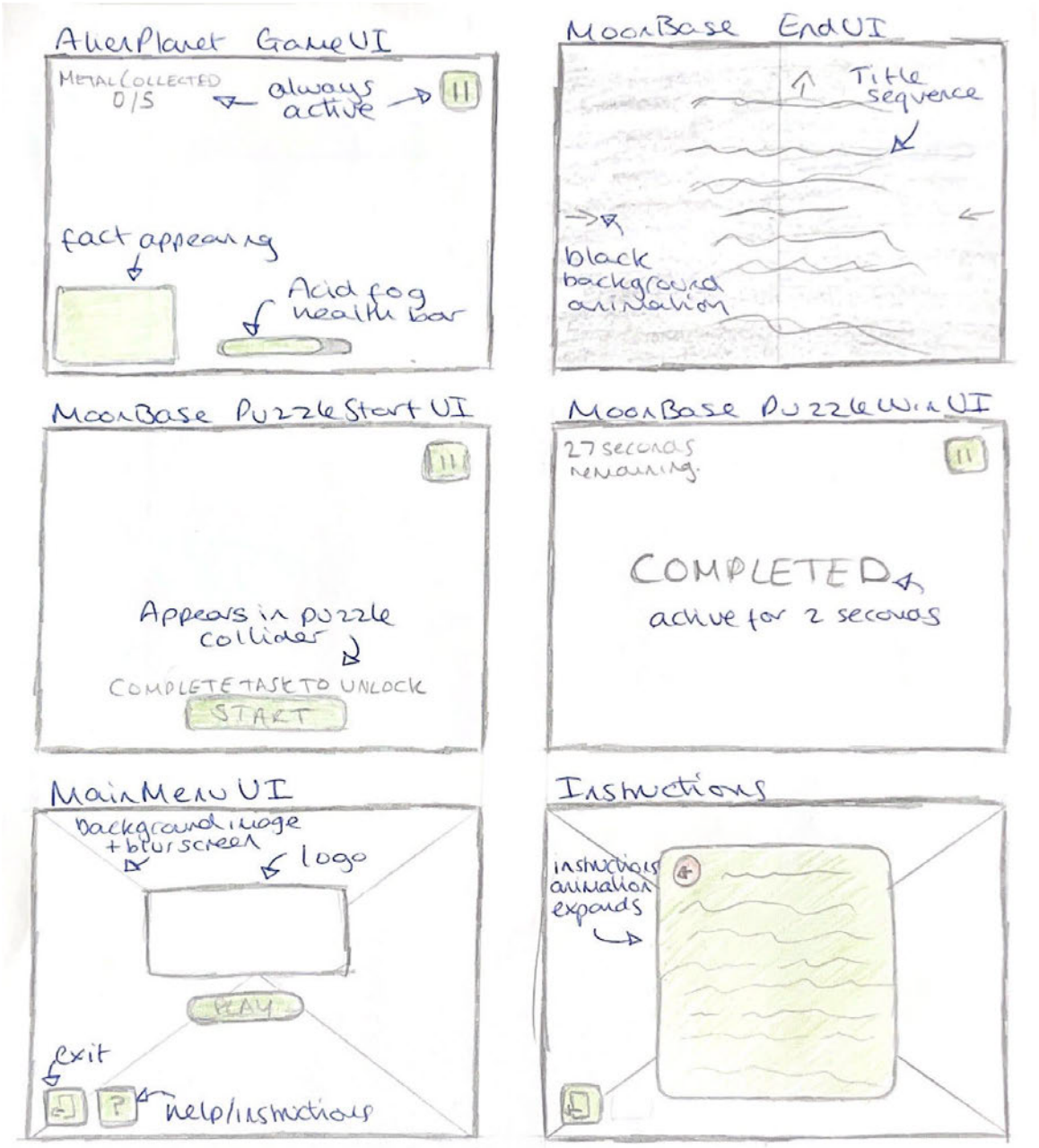
Appendix

Appendix A – Educational Content

Fact Title	In game text	Full information
Gravity	Gravity pulls object to the centre. Suns, moons and planets all have some gravity.	Gravity is the force that makes objects fall towards the ground. In space there is no gravity, which is why astronauts float. The sun has a very strong gravitation pull, that makes the planets orbit around it. The force of gravity also exists on the Moon, but it is not as strong as it is on Earth because the Moon is much smaller than our planet.
Rock Planets	These are made of rocks and metals. The four rocky planets are Mercury, Venus, Earth and Mars.	These are made of rocks and metals. The four rocky planets are Mercury, Venus, Earth and Mars and they are the closest four planets to the Sun. They have a solid surface and a core which is mainly made of iron. They are much smaller than the gas planets and rotate more slowly.
Gas Planets	They're balls of hydrogen and helium. The gas planets are Jupiter, Saturn, Uranus and Neptune.	They're balls of hydrogen and helium - you couldn't stand on the surface of the planet because it's not solid. The gas planets are Jupiter, Saturn, Uranus and Neptune. They are the furthest planets from the Sun, and each have many moons. They are much bigger than the rocky planets.
The Sun	The Sun is a star. It gives out heat and light and makes life possible on Earth.	The Sun is a star. It gives out heat and light and makes life possible on Earth. The heat and light from the Sun is felt and seen on Earth. Stars are orbited by planets. The Sun is roughly spherical in shape and is much, much bigger than the Earth. 1,300,000 times bigger!
Rockets		If you want to make a rocket go up, something needs to push down. So as the rapidly expanding gas from the burning fuel is forced down towards the ground, it forces the rocket up into the sky.
The Earth	The Earth was formed 4.5 billion years ago. The Earth takes a year to travel around the Sun.	4.5 billion years ago, clouds of rock and gas collided together to form the earth. Earth spins at 1000 miles per hour. It takes 24 hours to complete a full rotation. The Earth takes a year to travel around the Sun. Planet Earth has one moon, which is held in orbit by gravity.
Day & Night Cycle	The earth completes a full turn every 24 hours. This is why we have day and night.	When Britain faces the sun its daytime in Britain, but on the other side of the world in Australia it's the middle of the night. The earth rotates and as it rotates, the parts of the earth that were facing the sun turns away and faces the darkness. The earth completes on complete turn every 24 hours. This is why we have day and night.
The Solar System	There are eight planets in our solar system: Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus and Neptune.	Our Solar System formed about 4.6 billion years ago from a large cloud of gas and dust called a nebula. At the centre is our closest star, the Sun. Orbiting around the Sun are eight planets: Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus and Neptune.

Moons		A moon is an object that orbits a planet. Not all planets have a moon. We can see the Earth's Moon up in the sky. The other planets with moons are Mars, Jupiter, Saturn, Uranus and Neptune. Some moons are large and spherical like Earth's Moon. Many other moons are smaller and have a more irregular shape.
Spherical Objects	Gravity pulls objects into objects to the centre, which explains why planets, suns and moons are spherical.	We know the earth is round like a ball. Many years ago, people thought the earth was flat. Aristotle, from ancient Greece, noticed a ship's hull disappearing first over the horizon, which can only happen on a curved surface. We know that gravity pulls objects into objects to the centre, which explains why planets, suns and moons are spherical.
Asteroids	There are millions of asteroids in the Solar System, made out of rocky and metallic materials.	Asteroids are a group of small, irregular-shaped bodies located in the inner Solar System. Asteroids are made of rocky and metallic material, such as iron. There are millions of asteroids in the Solar System. The majority of asteroids orbit the Sun in the Asteroid Belt between the orbits of Mars and Jupiter.
Blackhole		A black hole is where gravity has become so strong that nothing around it can escape, not even light. They are formed when giant stars explode at the end of their lifecycle. If the star has enough mass, it will collapse on itself down to a very small size. Due to its small size and enormous mass, the gravity will be so strong it will absorb light and become a black hole.

Appendix B – UI sketches



Appendix C – Read Me file for user testing

1. Open and read the Participant Information sheet.

2. Open the Informed Consent Form. Please fill in the details, and then send the completed form back to am2769@york.ac.uk.

3. Download the UserTesting.zip folder and extract it. This is the game you are testing.
   Note: Only open the OutOfThisPlanet.exe file, when instructed to do so in the form. The other files are there to ensure the game runs on your device.

4. Open the Usability Testing form and follow the instructions on the form.

Appendix D – Information Sheet

UNIVERSITY of York

Department of Theatre, Film, Television and

Interactive Media Ethics Committee

Participant Information Sheet –Anonymous Research

Project background

The University of York would like to invite you to take part in the following project: An educational experience integrating intrinsic motivation.

Before agreeing to take part, please read this information sheet carefully and let us know if anything is unclear or you would like further information.

What is the purpose of the project?

This project is being performed by Ania Mahmood ([redacted], a 3rd year undergraduate student in BSc Interactive Media at the University of York. This project is being supervised by Florian [redacted] ([redacted]). The research conducted is undertaken as part of the Interactive Media Individual Project, led by Debbie [redacted] ([redacted]).

The work that is being performed for the assessments within the module is being conducted according to restrictions that have been subject to approval by the TFTI Ethics committee. The Chair of the TFTI Ethics committee can be contacted on TFTI-ethics@york.ac.uk.

For this research project, we are interested in providing an interactive and engaging educational experience for young children, by integrating intrinsic motivation. Your participation in this project will involve taking part in a remote individual questionnaire (e.g. using Google Forms) and remote testing of a game, to help us identify key requirements and opportunities for creating a educational yet exciting game. This process will last around 30 minutes.

Please note that to comply with the approved Ethics requirements of this work, we do not intend to discuss sensitive topics with you that could be potentially upsetting or distressing. If you have any concerns about the topics that may be covered in the research study, please raise these concerns with the researcher.

Your participation in this project is voluntary. If you wish, we will provide you with access to the final project report and other outputs from the project. If you would like to receive access to these, you can indicate as such on the consent form.

Why have I been invited to take part?

You have been invited to take part because you have some understanding of children's education and learning, by either being a parent or a teacher, or have some level of knowledge of games mechanics, by either creating or playing games.

Do I have to take part?

No, participation is optional. If you do decide to take part, you will be given a copy of this information sheet for your records and will be asked to complete a participant consent form. If you change your mind at any point during the research activity, you will be able to withdraw your participation without having to provide a reason. To withdraw your participation, you need to let the researcher know by email ([redacted]) and all your data will be deleted as soon as possible.

Will I be identified in any outputs?

No. Your participation in this research activity will be treated anonymously and you will not be identified in any outputs.

Privacy Notice

This section explains how personal data will be used by Salt on the Screen at the University of York.

For this project, the University of York is the Data Controller. We are registered with the Information Commissioner's Office. Our registration number is Z4855807.

What is our legal basis for processing your data?

Privacy law (the UK General Data Protection Regulation (GDPR) and Data Protection Act 2018) requires us to have a legal reason to process your personal data. Our reason is we need it to perform a public task.[1]

[1]This refers to UK GDPR Article 6 (1) (e): processing is necessary for the performance of a task carried out in the public interest or in the exercise of official authority vested in the controller

This is because the University has a public function, which includes carrying out research projects.[2] We need to use personal data in order to carry out this research project.

Information about your health, ethnicity, sexual identity and other sensitive information is called "special category" data. We have to have an additional legal reason to use this data, because it is sensitive. Our reason is that it is needed for research purposes.[3] All research projects at the University follow our research ethics policies.

How do we use your data?

Data will be processed for the purposes outlined in this notice.

Who do we share your data with?

Your data may be shared with Florian [redacted] as they are the individual academic supervisor of the researcher. The data will by anonymised for before submission, therefore any personal data will be redacted.

As well as this, we use computer software or systems to hold and manage data. Other companies only provide the software, system or storage. They are not allowed to use your data for their own reasons.

We have agreements in place when we share data. These agreements meet legal requirements to ensure your data is protected.

How do we keep your data secure?

The University is serious about keeping your data secure and protecting your rights to privacy. We don't ask you for data we don't need, and only give access to people who need to know. We think about security when planning projects, to make sure they work well. Our IT security team checks regularly to make sure we're taking the right steps. For more details see our security webpages.

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[2] Our charter and statutes states: 4.f. To provide instruction in such branches of learning as the University may think fit and to make provision for research and for the advancement and dissemination of knowledge in such manner as the University may determine.

[3] This refers to UK GDPR Article 9 (2) (j): processing is necessary for archiving purposes in the public interest, scientific or historical research purposes or statistical purposes in accordance with Article 89(1) based on Union or Member State law which shall be proportionate to the aim pursued, respect the essence of the right to data protection and provide for suitable and specific measures to safeguard the fundamental rights and the interests of the data subject.

How do we transfer your data safely internationally?

If your data is stored or processed outside the UK, we follow legal requirements to make sure that the same level of privacy rules still apply.

How long will we keep your data?

The University has rules in place for how long research data can be kept when the research project is finished. Your information will be kept for 6 months and after this time an anonymised version will be kept. As this will be fully anonymous, it will not be possible to identify you in any way from this data.

What rights do you have in relation to your data?

You have rights over your data. This sheet explains how you can stop participating in the study, and what will happen to your data if you do. This information is in the section 'Do I have to take part?'.

If you want to get a copy of your data, or talk to us about any other rights, please contact us using the details below.

Questions or concerns

If you have any questions or concerns about how your data is being processed, please contact the Ania Mahmood ([redacted], or Debbie [redacted]([redacted]).

If you have further questions, the University's Data Protection Officer can be contacted at dataprotection@york.ac.uk or by writing to: **Data Protection Officer, University of York, Heslington, York, YO10 5DD**.

Right to complain

If you are unhappy with the way in which the University has handled your personal data, you have a right to complain to the Information Commissioner's Office. For information on reporting a concern to the Information Commissioner's Office, see www.ico.org.uk/concerns.

Appendix E – Blank Consent Form

An educational experience integrating intrinsic motivation.

UNIVERSITY of York

Department of Theatre, Film, Television and Interactive Media Ethics Committee

Participant Consent Form

Thank you for your interest in this project. This project aims to evaluate the effectiveness of providing an interactive and engaging educational experience for young children, by integrating intrinsic motivation.

Please read the following statements carefully and tick the appropriate box:

	YES	NO
I have read the information sheet about this project		
I agree to take part in this project		
I consent to testing a game		
I consent to filling out a questionnaire to share my opinions of the game		
I understand my right to withdraw and/or have my data destroyed from this project at any time		
I understand that my participation in this project will be treated anonymously		
I am over the age of 18		

Participant Name:

_____

Participant Signature:

_____

Date:

____/____/____

Researcher Name:

_____

Researcher Signature:

_____

Date:

____/____/____

If you wish to be informed about the outcomes from this project, please provide your email address: _____

Appendix F – Blank user testing questionnaire

Out of this Planet - User Testing

This online questionnaire is part of a student project for a Interactive Media Individual Project module at University of York, UK. The survey aims to gather information on your opinions of a game that provides an interactive and engaging educational experience for young children, by integrating intrinsic motivation. The results of this testing will help me to evaluate the success of the project against the project aims and to made improvements. The estimated completion time for the survey is 30 minutes.

The survey is conducted by Ania Mahmood (am2769@york.ac.uk).

All data will be gathered and reported anonymously.

All data collected will be destroyed after the final marks for the academic year have been ratified.

Please read the information sheet about the project here to understand how your data will be processed:
https://drive.google.com/file/d/1YLgRikm4eDJZH3MqI1r2Kqf1G_ugNXci/view?usp=sharing

Before proceeding on, please fill out the informed consent form:
https://docs.google.com/document/d/1qdCmF6ZaFr7dCYyQBYmv_mZqqe9ntjnMWU5rUBfBrFs/edit?usp=sharing

am2769@york.ac.uk (not shared) Switch accounts

*Required

I confirm that I have read the information sheet (linked above) and agree to take part in the survey. *

- ◯ Yes
- ◯ No

I confirm that I have filled out the Informed Consent Form linked above. *

- ◯ Yes
- ◯ No

Verification of age

I confirm that I am 18 years old or older. *

- ◯ Yes
- ◯ No

Task

For this project, you will be asked to play the game and describe your experience after by answering some questions. For some context, this is an educational game about earth and space. The information included in the game is tailored to meet the national curriculum for Key Stage 2 children.

When playing the game please consider the following things:
1. The accuracy of the educational content included
2. The gaming skills required to play
3. The design and usability of the game

Download the UserTesting.zip folder and extract the files. The open the OutOfThisPlanet.exe file to play. You can play the game as many times as you want in order to get the full experience before moving on to the next section.

Questions

Now, you will need to answer a few questions on your experience of playing this game. You will be asked a mix of questions about the design, usability and educational content of this game. There are no right or wrong answers.

You can refer back to the game, if you need a refresher.

Describe your opinions on the 2D user interface design of the game. This includes the main menu, pause screen, any text on screen etc. Please include any positive and/or negative feedback. *

Your answer

Describe your opinions on the 3D world design of the game. This includes any objects and assets in the game, for the alien planet and the moon base. Please include any positive and/or negative feedback. *

Your answer

What are your opinions on the narrative of the game? How effective is the game in creating a story around the information about Earth and space? *

Your answer

With a child's perspective in mind, do you think this game mixes the focus on education with entertainment effectively, and why? *

Your answer

Do you think the game effectively incorporates intrinsic motivation to play this game? It not, how could this be improved? *

Your answer

Do you think the game controls suits the skill level of key stage 2 children? How could this be improved? *

Your answer

Do you think the usability of the game suits the needs for key stage 2 children? How could this be improved to make the game easy to navigate? *

Your answer

Are there any bugs or issues you have noticed? If so, please describe them. *

Your answer

Are there any positives that stood out? If so, please describe them. *

Your answer

Appendix G – Questionnaire findings

Questions

Describe your opinions on the 2D user interface design of the game. This includes the main menu, pause screen, any text on screen etc. Please include any positive and/or negative feedback.

4 responses

The UI all followed the same theme and style, which suits the game and intended audience. There were some errors and things that could be improved. Some spelling and grammar issues in the facts about black holes and the day and night cycle. The fact buttons should change colour when active, as I kept forgetting which one I was on.

very eyecatching. could do with labelling the icons. space bar to jump was not included. The buttons on the facts were not obvious enough, and the font of the fact text could be better. An explanation f how to complete the puzzle might be useful.

The key controls should be displayed at the start of the game. I like the colours and font used. The metals collected text isn't very noticeable.

The icons were clear to see and its fairly obvious what they mean, however they need labelling. There should be a window that pops up when you press exit, asking for conformation.

Describe your opinions on the 3D world design of the game. This includes any objects and assets in the game, for the alien planet and the moon base. Please include any positive and/or negative feedback.

4 responses

This looked great. Especially the moon base as it looks realistic but clearly has the stylized look.

Jump steps could be bigger as it was too hard. I liked the water audio but that area was a bit plain, more trees and rocks. It might be good to include a mini of the maze. Too many asteroids but I liked this feature. I liked the design of the hot springs and radiation. The desert section could do with some brighter colours. The moonbase needs to be brighter.

the maze is a bit hard to navigate. There could be more collectable items, because some areas are a bit boring. However, i like that the design of the alien planet uses natural elements like rocks and trees, so all the obstacles don't seem manmade.

I like that there are multiple seconds, such as the forest, crater and moon base. It keeps the players attention throughout.

What are your opinions on the narrative of the game? How effective is the game in creating a story around the information about Earth and space?

4 responses

I think the story works well as it all flows in a way that makes sense. So finding a new ship but collecting metal to restore the ship. Also having a moon base to include information about the earth and solar system.

Everything flows and its very cohesive. The facts were in reasonable places.

I like the way that each fact fits in with whats going on in the game. could use more facts.

I think it flows nicely. Each section fits well with the previous. The audios at the start describing what to do are very helpful.

With a child's perspective in mind, do you think this game mixes the focus on education with entertainment effectively, and why?

4 responses

I would say so. I do think that they might be more focused on the game rather the information, so maybe if there was a way to use the information that they learnt would be beneficial. But in terms of creating a game that uses intrinsic motivation, this game certainly does so.

Yes because when you're completing a certain obstacle the relevant information appears. However the text wasn't eye-catching enough.

Yes you learn some cool facts while playing a fun game. Kids might just ignore the facts, but I guess thats inevitable when the focus is to use intrinsic motivation.

For the most part yes, but as a teacher I can see this game being used for more personal enjoyment.

Do you think the game effectively incorporates intrinsic motivation to play this game? It not, how could this be improved?

4 responses

Yes, as the game isn't heavily pushing information onto the player, but its still there. I even learnt a fact whilst playing the game.

Yes, the game incorporates both educational and personal enjoyment. The game has the facade of being entertaining , yet it clearly is able to be educational, helping with knowledge.

Yes, because the information isnt too in your face, where its obvious that the game is for educational purposes. I can see my child wanting to play this for fun, and then if they learn a little something, that's a bonus.

Yes, as stated earlier, the game feels like it would be used for personal enjoyment more than educational purposes, but I think that this is an effective way to get information across to an age group that get distracted easily and can be reluctant to learn. I would use this game in my classroom to allow the students to receive information in an interactive way. However, this would not replace current techniques.

Do you think the game controls suits the skill level of key stage 2 children? How could this be improved?

4 responses

I think the control sensitivity should be lowered. The turn speed especially might be too fast for younger players. Also they may struggle with the jumping steps at the start. so making these bigger could be useful.

Yes, the controls are able to be understood by KS2 child, however, they should all be clearly labelled.

The jumping was a little difficult. I can imagine kids spamming the jump button, which causes the player to kind of glitch.

I personally do not play many games, so it took some getting used to for me. But there isnt anything that I can point out that makes it overly difficult. I'm sure many students would be fine, as long as the controls are displayed and explained clearly.

Do you think the usability of the game suits the needs for key stage 2 children? How could this be improved to make the game easy to navigate?

4 responses

The buttons on the main menu could be labelled, as they might not know what the symbols mean. Other than that it is very easy to navigate each scene.

Yes, just needs proper labelling.

Mostly yes, as the layout if fairly simple. There should be a way to save your progress so you can leave the game half way through, to come back at another time. I can imagine kids having a short attention span.

It would be easier to navigate if the buttons were labelled.

Are there any bugs or issues you have noticed? If so, please describe them.

4 responses

The audio doesn't pause with the game, so its no longer synced up. Also the background audio needs looping. I was also able to go through a wall in the maze.

Could go through the walls in the maze.

Player can go through some of the walls

When pausing the game at the start, the audio was no longer in sync. The audio of the ship crashed played before the ship actually crashed.

Are there any positives that stood out? If so, please describe them.

4 responses

The music fits very well with the game. And the different animations were also impressive.

The animations

I liked that you tried to keep some things as realistic as possible. For example there wasnt any aliens or things that make it seem like fantasy.

I like the length of this game. The amount of information given and the duration of the game is just the right amount. I could get the children to play this game, without it taking up too much time, and without them getting bored.

Appendix H – Ethics Checklist

UNIVERSITY of York

Department of Theatre, Film, Television and Interactive Media Ethics Committee

RESEARCH ETHICS CHECKLIST FOR TAUGHT STUDENTS FOR PROJECTS USING DEPARTMENT

LEVEL ETHICS PRE-APPROVAL

This checklist is to be used **ONLY** for research work by TFTI students who wish to use the Department Level Ethics Pre-Approval to accommodate the ethical risks of their proposed research work.

Students must ensure that their proposed research work can be accommodated by the restrictions in this Checklist. If not, you will be unable to conduct the work without further Ethical scrutiny by the TFTI Ethics Committee as the work is considered to have higher ethical risks. To apply for additional Ethics approval, you must submit the Research Ethics Clearance Form for review by the TFTI Ethics Committee. However, please note that some modules DO NOT permit students to submit individual Ethics applications.

All students who use the Department Level Ethics Pre-Approval for their work must complete this checklist and include the following as Appendices to their assessment reports:

- This completed Checklist;
- Example Participant Information Sheets and Participant Informed Consent Forms, if appropriate;

Please note that if this Ethics Checklist is associated with an assessment that has an **anonymous submission** (i.e. if you are using your Exam Number, Y123456 for submission) you **MUST** redact your name and any other information that would identify you as an individual from the appendices before submission.

Please note that your assessment markers will compare the submitted assessment work to this Ethics Checklist, Information Sheets and Consent Forms to ensure compliance.

You are also required to conduct this research work in compliance with the General Data Protection Regulation (GDPR). Information on how to ensure compliance is available on the TFTI Ethics VLE site.

Before completing this Research Ethics Checklist for Taught Students, please consult the TFTI Ethics VLE Site for guidance and further information.

SECTION 1: STUDENT AND PROJECT DETAILS

Box 1A: Student Details **ALL** students must complete this box	
Student Name OR Exam Number for Anonymous Submission	Ania Mahmood
Degree Title	Interactive Media
Stage (e.g. 2nd year Undergraduate)	3rd year undergraduate
Role in Project (e.g. Team Leader)	

Box 1B: Project Details **ALL** students must complete this box	
Module Title and Module Code	Interactive Media Individual Project TFT00024H
Project Supervisor Name and Email Address	[redacted]

Box 1C: Project Details **ALL** students must complete this box	
Project Title	Interactive Media Individual Project
Project Submission Date	26th May 2022

Please complete Section 2: Research Ethics Concerns

SECTION 2: RESEARCH ETHICS CONCERNS

Box 2A: Checklist of Research Ethics Questions **ALL** students must complete this box		**YES**	**NO**
1	Will the project involve conducting work that would typically require NHS Ethics approval? That is, will you be working with any of the following as participants, if recruited specifically due to their involvement with the NHS: - Patients and Users of the NHS, - Relatives or carers of patients and users of the NHS, - NHS staff? OR will you be using or accessing NHS premises or facilities as part of the work?		X
2	Will the project involve conducting work that would typically require Her Majesty's Prison & Probation Service Ethics approval? That is, will you be conducting research with staff and/or offenders in prison establishments, National Probation Service (NPS)/Community Rehabilitation Companies (CRC) regions or within Her Majesty's Prison and Probation Service (HMPPS) Headquarters? OR will you be conducting research on HMPPS premises?		X
3	Will you be working with vulnerable participants (e.g. those under 18, people with learning disabilities, people with mental impairment due to health or lifestyle, people who are terminally ill or recently bereaved etc.)? Note that if you are unsure whether someone you would like to work with could be considered vulnerable under the circumstances, you are required to discuss your concerns with the module leader, your supervisor and/or Ethics Chair. It is generally expected that any student working with vulnerable groups would submit the longer Research Ethics Clearance form.		X
4	Will you be identifying any of the participants in your outputs?		X
5	Will you be discussing sensitive or potentially upsetting or distressing topics with participants?		X

Box 2A: Checklist of Research Ethics Questions **ALL** students must complete this box		**YES**	**NO**
6	Is it reasonably foreseeable that the work could involve causing physical or emotional distress to participants or researchers?		X
7	Is it reasonably foreseeable that the participants could disclose or discuss participation in illegal activities (e.g. drug use)?		X
8	Is it reasonably foreseeable that the participants could disclose confidential or sensitive information (e.g. financial data, sensitive organisational data)?		X
9	Will you be deliberately misleading the participants in any way?		X
10	Will you be filming or making recordings of people without their knowledge and consent (e.g. covert filming of people in non-public places)?		X
11	Will you be researching or discussing issues relating to terrorism or political extremism as part of your work?		X
12	Will you be collecting online data that has been generated by human participants (e.g. social media data) from closed, restricted forums (i.e. from closed communities or those that require approved membership to view, e.g. restricted Facebook groups)?		X
13	Will you be identifying anyone from online data that has been generated by human participants (e.g. social media data) from either open or closed forums (i.e. by including information that could make the individual identifiable, such as direct quotes or usernames)?		X
14	Could the work involve potentially damaging property and/or the natural environment?		X
15	Will the work involve animals?		X
16	Is it reasonably foreseeable that the work could result in any anticipated university/institutional risk (e.g. adverse publicity or financial loss)?		X
17	Will you be compensating participants with financial inducements **OTHER THAN** reasonable incentives (e.g. chocolate, cake) for the inconvenience?		X

Box 2A: Checklist of Research Ethics Questions **ALL** students must complete this box		**YES**	**NO**
18	Will you be paying participant expenses?		X
19	Will you be conducting any of the work for this project **OUTSIDE** of the UK?		X

If you have answered "YES" to ANY of the questions in Box 2A: Checklist of Research Ethics Questions:

The Department Level Ethics Pre-Approval together with this Research Ethics Checklist for Taught Students MAY be insufficient to accommodate the ethical risks of your proposed work.

Some lower-risk ethical issues can be accommodated without further Ethical scrutiny provided that you agree to follow a process that is considered appropriate. These situations and processes are described on the TFTI Ethics VLE site.

IF there is a suitable procedure to manage this ethics issue, please complete Box 2B to provide further details of how you intend to manage the ethical issues associated with your proposed work in consultation with either the module convenor or your assessment supervisor.

Box 2B: Further Details

Complete this box if you answered "Yes" to any question in Box 2A AND there is an identified procedure to manage the ethical risks in this situation.

Provide details of the nature of the ethical risks that you identified by answering YES to questions in Box 2A and describe the process that you will follow to minimise the risks.

Please note that if you answered YES to Question 17 and/or 18:

If research participants are to receive any payments, reimbursement of expenses, or any other incentives or benefits for taking part in your research, please give details, indicating what and how much they will receive and the basis on which this was decided. Please also explain how you will ensure that you are complying with financial regulations. The University's policy on payment to participants in research projects is in line with HMRC guidelines:

https://www.york.ac.uk/admin/hr/policies/appointments-contracts-leavers/employment-status-interns-work-experience-etc/guidance/.

If you wish to compensate participants for time spent on a project, commensurate with equivalent earnings for the participant, you have to enter into a 'casual employment' relationship, adding participants to the University payroll. Right To Work checks are required and there are also tax implications. Otherwise, participants can be paid reasonable expenses (travel and subsistence) plus a token acknowledgement of £10 for up to a half day's participation, £25 for a whole day.

Alternatively, the associated risks of your proposed work may be sufficiently low risk that an appropriate approach can be agreed with the TFTI Ethics chair without requiring submission of the TFTI Research Ethics Clearance form. Your supervisor/module convenor may contact the TFTI Ethics on your behalf to identify an agreed process on a case-by-case basis. If your supervisor has discussed your proposed work with the TFTI Ethics Chair via email, please complete Box 2C: Case-By-Case Agreed Process.

Box 2C: Case-By-Case Agreed Process Students must complete this box IF they have answered "YES" to any questions in Box 2A AND there is no identified procedure to manage the ethical risks of the proposed work. Note, that most students will need to submit a TFTI Research Ethics Clearance form and this case-by-case process approach is ONLY suitable for work that can be considered low risk.		**YES**	**NO**
1	Has your project supervisor or module convenor discussed the proposed work and associated ethical risks with the TFTI Ethics Chair via email?		
2	Was your project supervisor or module convenor able to agree a process to manage the low risks associated with your proposed work?		
IF YES to BOTH questions please provide further details of the anticipated risks of the proposed work and the process that was agreed with the TFTI Ethics chair. Please include dates of the email correspondence AND the name and email address of supervisor/module convenor involved.			

If the associated risks of your proposed work cannot be accommodated through an identified procedure or through a case-by-case agreed process then, provided the module convenor permits it, you will need to submit an application to the TFTI Ethics Committee for review using the Research Ethics Clearance Form. But, please note that some modules do NOT permit students to submit individual applications to the Ethics Committee.

Please complete Section 3: Data Protection

SECTION 3: DATA PROTECTION

In order to comply with the General Data Protection Regulation (GDPR) you MUST adhere to the data usage and storage principles described in Box 3A: Checklist of Data Protection Questions.

Box 3A: Checklist of Data Protection Questions **ALL** students must complete this box		**YES**	**NO**
1	Will you guarantee that you will inform all people whose personal and/or special category data that you are using: • What data you will be collecting and why; • How you will be storing the data; • The legal basis under which you are storing the data; • When/if/how the data will be destroyed? Please note that using a GDPR Compliant Project Information Sheet will ensure you meet these requirements.	X	
2	Will you guarantee that **IF** you use a portable device to collect electronic data you will transfer that data to your University Google Drive account or University Filestore as soon as possible after the interview **AND** delete it from your personal device?	X	
3	Will you guarantee that the data will **ONLY** be accessible to the project team **AND** that **IF** the project team extends beyond the University of York that you have consulted the University's IP and Legal team to ensure appropriate data protection safeguards are in place?	X	
4	Will you guarantee that you will **ONLY** use Google Forms OR Qualtrics to host online surveys that collect personal and/or special category data?	X	
5	Will you guarantee that you are collecting the **MINIMUM** amount of data necessary for the intended project?	X	
6	Will you guarantee that **IF** you are storing or accessing data from **OUTSIDE** the European Economic Area (EEA) you will access the data through your University of York Google Account connected to the University of York Virtual Private Network (VPN)?	X	

Box 3A: Checklist of Data Protection Questions **ALL** students must complete this box		**YES**	**NO**
7	Will you guarantee to destroy all physical **AND** electronic data **EITHER** after your module marks have been ratified by the Board of Examiners **OR** 10 years after last requested access?	X	
8	**IF** storing electronic data for 10 years after last requested access, will you guarantee to **EITHER** use a University Google Drive account **OR** an approved data repository service to store the data?	X	
9	Have you screened your project against the Data Protection Impact Assessment (DPIA) screening questions **AND** if required conducted a DPIA and submitted a copy to the Data Protection Officer for review?	N/A	
10	If capturing audio, will you use an encrypted device for recording (e.g. an Apple iOS device or encrypted voice recorder)?	X	
11	Where data is held on an encrypted portable device (e.g. laptop, tablet) will you back it up to a University approved service as soon as possible and perform periodic checks to ensure data is being backed up appropriately?	X	
12	Will you ensure confidential information is encrypted before it is transmitted/shared digitally?	X	
13	Please detail what other protections will be used for digital data (e.g. access/edit permissions, procedural safeguards re downloads/making copies, remote access via VDS/VPN, 2 factor authentication)?		
	Give answer here:		
14	Confirm you have reviewed the user commitments under the Policy for the safe use of University information on devices. Detail anything in the user commitments that will pose a challenge in carrying out your proposed research.		
	Give answer to the second element of question 14 here:		

Box 3A: Checklist of Data Protection Questions **ALL** students must complete this box		**YES**	**NO**
15	Will you ensure that personal data or confidential data held on paper are stored in a lockable filing cabinet or container, and/or a locked room in secure premises?	X	
16	How will devices be physically protected (e.g. in transit, when not in use or left unattended)?		
	Give answer here: All devices will be either a) password protected laptops, or b) secure, e.g. biometric/security number mobile devices.		
17	Will you ensure the device(s), accounts, or storage area(s) used to store data are not accessible to any unauthorised parties?	X	

Box 3B: Checklist of Data Retention Questions **ALL** applicants must complete this box		**YES**	**NO**
1	How long will you keep personal data after the project, in what form and for what reason? https://www.york.ac.uk/library/info-for/researchers/data/sharing/		
	Give answer here: Data will be stored until marks have been ratified.		
2	When will the research data be destroyed, by whom, and how? https://www.york.ac.uk/library/info-for/researchers/data/sharing/#tab-2		
	Give answer here: Data will be stored until marks have been ratified, then will be deleted of personal and googles drives.		

Box 3B: Checklist of Data Retention Questions **ALL** applicants must complete this box		**YES**	**NO**
3	Will any personal or special category data (i.e. data that is not truly and irrevocably anonymised) be deposited in an archive or external repository? https://www.york.ac.uk/library/info-for/researchers/data/sharing/#tab-4		X
4	Where personal data are to be transferred to an archive or repository, please confirm that your Information Sheet will: (i) cover the archiving and reuse of any personal data and participant agreement to this, (ii) explain to participants the benefits of any data sharing, (iii) indicate where possible whether research data will be deposited in a named, recognised repository (e.g. Archaeology Data Service, UK Data Service, York's institutional repository, etc.)	N/A	
5	Where you have special category personal data or criminal data, will it be destroyed in line with an agreed retention policy (set by the University, the data provider, or approved by this ethics committee)?	X	

Before submission of your assessment work, you must complete Section 4: Student Agreement. This completed Checklist must be included as an Appendix to your assessment report, together with examples of your Project Information Sheets and Informed Consent Forms.

SECTION 4: STUDENT AGREEMENT

Box 4A: Student Agreement **ALL students must complete this box.**		**YES**	**NO**	**N/A**
1	I confirm that the work conducted for the above project has met all the statements as expressed in this Research Ethics Checklist.	X		
2	I confirm that the work conducted for the above project was guided by the University's ethical rules and regulations.	X		
3	I have included example Project Information Sheets and Informed Consent Forms as Appendices to my report, if applicable.	X		
4	I confirm that I have adhered to the TFTI requirements for storing personal and special category data compliant with the General Data Protection Regulation (GDPR). Note that GDPR compliance guidance can be found on the TFTI Ethics VLE site.	X		
5	I confirm that, if applicable, all payments made to personnel in relation to this project have complied with financial regulations.			X
Student Name **(or Exam Number for Anonymous Submission)**		Ania Mahmood		
Date		02/05/2022		