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The University on Lincoln Island: Reimagining a University Campus as a Role-Playing Video Game

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Abstract

This paper presents the University of Lincoln Island (TULI), a work-in-progress project where the University of Lincoln campus has been recreated digitally and re-imagined as a fantasy role-playing computer game. Universities have had to respond to a number of key challenges in response to the COVID-19 pandemic. Moving teaching and research online has been facilitated by a number of mature software platforms and tool-sets and the institutional expertise to wield them. However, there are fewer core activities that have digital provisions, thereby requiring a more creative approach. One of these areas is campus familiarisation, traditionally managed through timetabled events such as guided tours and scavenger hunts. However, these activities will be untenable until social distancing measures are lifted, forcing us to consider alternatives. This paper presents gamified virtual environments as a digital solution to support students in this area. We identify a number of key challenges and opportunities in the hopes that it will provide insight for future work in this domain.

CCS Concepts

• ***Applied computing*** → ***Education;*** • ***Software and its engineering*** → ***Virtual worlds software;***

1. Background and Motivation

The outbreak of COVID-19 resulted in the education sector quickly moving learning from physical spaces to digital platforms to support social distancing. Thus, the sector responded to what was (arguably) the most disruptive event to have happened in the past 100 years. However, although the circumstances are unique, we are served by a significant body of experience in online learning. A pedagogy of digital education has been developing since materials were available via the internet in 1960 [AP13].

Moving beyond this initial response, we are faced with a range of new challenges. Notably, any activity that would typically require individuals to visit or be present on the physical campus. An example of this would be pre-events, where prospective students are invited to visit the campus. Beyond a recruitment activity, these days are an important opportunity for new students to experience the university environment aiding in their transition; however, moving these activities online has traditionally proven challenging [Mck13].

The reality is that it is hard to replicate the experience of being physically grounded in the environment with the freedom to explore. We had recognised this reality before, as there was a period in the early 2000's when many universities invested in large scale virtual campus experiments on the virtual world platform SecondLife [Kir07]. However, these endeavours often failed in their accessibility, and when the user-base of SecondLife dropped, so did interest in this style of engagement. However, improved hardware standards, faster internet and developments in game-engine technology provided new opportunities in this space. This, combined with the necessity to support student transition during social distancing, encouraged us to develop the University on Lincoln Island (TULI) project.

For new university students, navigating around the campus can be a potentially daunting and anxiety-inducing task. There is a risk that anxiety may cause individuals to avoid situations if they deem them too overwhelming [Mat09]. Due to the outcomes of COVID-19, students will not receive the same introduction to campus as previous applicants had. Notably, they will have less freedom to casually explore and become acquainted with the campus in their own time. Therefore, this could take individuals a long time to get accustomed to the layout of the campus and may increase the chances of these students getting lost and could cause students to be anxious about exploring the campus.

Several universities offer interactive maps and route planners, which can be helpful when trying to find an available route but does not help students learn environmental markers. This process is called Allocentric Navigation, in which individuals use environmental cues such as visual, auditory or olfactory to determine their location to navigate to a goal location [WK04]. However, if individuals are within unfamiliar surroundings, the environmental cues may be unknown to them. A video game environment may help develop these cues to cater to the Allocentric navigation style.

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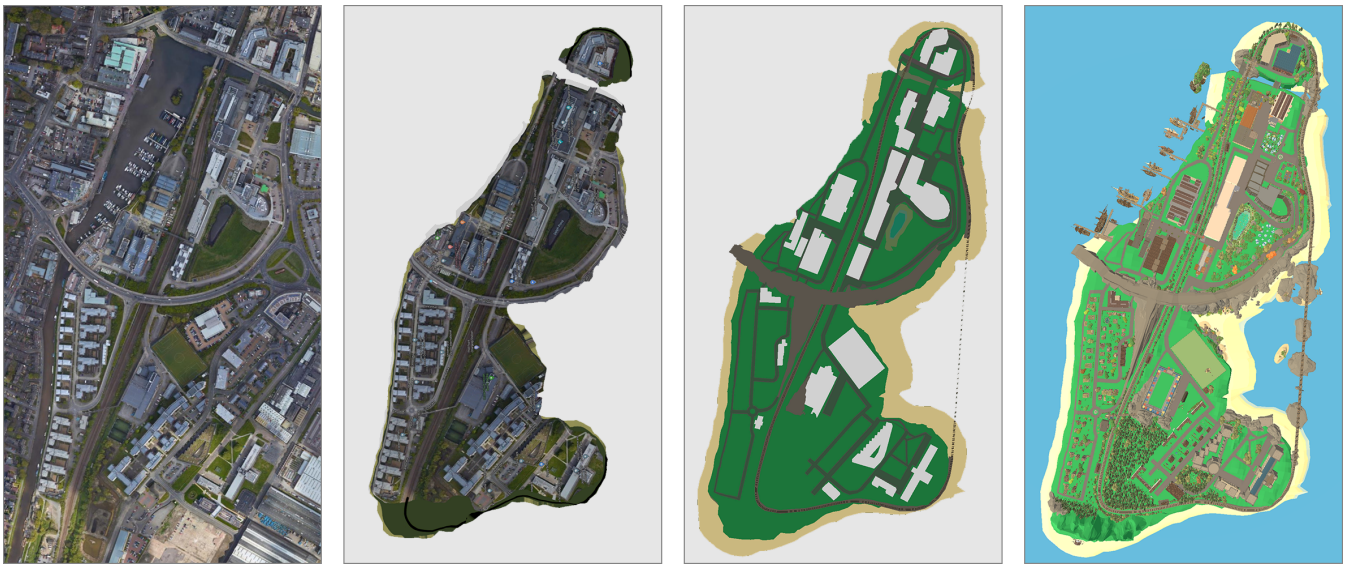

Figure 1: *A sequence illustrating the Lincoln Island development process, starting from an aerial photo of the campus (left); to a rough-cut 'island' made by excluding all non-campus areas; to a 3D vector-map, with placeholder buildings; and finally a completed virtual environment (right) with all placeholder content replaced by 3D models.*

1.1. Examples of anxiety reduction and prevention games

Dojo (by GameDesk) is a biofeedback game that assists users in addressing their emotions to manage their anxiety. The game is split into three trials: fear, frustration and anger. Each room contains emotional challenges that guide, teaching them coping mechanisms to manage responses during the trials. These techniques are utilised within Cognitive Behavioural Therapy (CBT) and follow the same therapeutic principles; this includes breathing practices, positive self-talk, progressive muscles techniques, and guided imagery [SNV*15]. A study by Schuurmans (2015) concluded that by using the Spence Children's Anxiety Scale, participants reported that scores showed a decrease from baseline to post-test [SNV*15]. The baseline score started at 23.25 and decreased to 16.38 post-test, showing that the participant's self-reported anxiety levels decreased by 6.87. This demonstrates that a gamified intervention can be used to successful decrease anxiety levels.

Another way to prevent and reduce anxiety is through puzzle games. Lowney (1998) used a 100 piece puzzle to reduce anxiety within the students taking statistics and research methods class. The first aim of the exercise was to immediately engage the students to redirect them from their anxieties [Low98]. Secondly, developing an analytical mindset when approaching the puzzle could help students apply theoretical theories within the module. Finally, the fun aspect of the puzzle will relieve the tension among the students. Within evaluations, students reported that the exercise was a "*confidence builder*" and a "*breakthrough in helping to relax*" [Low98]. Lowney (1998) concluded that the puzzle assisted in reducing the "*fear of theorising*" as it changed the student's perspective, helping them engage in challenging theoretical practices.

2. Transitional Games

The Lincoln Island project was designed with the intended goal of helping to facilitate the student transition into university and could essentially be classed as a Transitional Game. A Transitional Game can be defined as:

> A subset of Serious Games, with the aim of supporting a group or individual through a period of transition, whether it be emotional or physical.

Transitional Games has not been previously defined within literature and thus opens a whole new classification of Serious Games used by the Health Care and Education industries. The skeletal structure of a Transitional Game is similar to that of Serious Games; it must have a purpose other than for pure entertainment [DAJ11]. For example, it should have a pedagogic value. In essence, a Transitional Game should act as a learning tool to teach and educate individuals through the transition. The pedagogical learning elements within a Transitional Game are represented using coping mechanisms and improvement of life skills. These abilities involve improving communication and skills, creating a positive mindset, and managing stress responses. Moreover, a Transitional Game could teach the individual about their new transitioned reality, which could help accept the change. Typically transitions within life are regarded as a passage from one life phase, condition, or status to another [Bri04]. Examples of transitions include job promotion, divorce, retirement, and in this case, students moving to university [Whe90].

With reference to Lincoln Island, the game acts as a virtual open-world simulation of the Brayford Campus. Quests, such as finding various buildings within the environment, represent the game's pedagogic value, guiding individuals around the campus that facilitates the memorisation of building placement. This game design

element could help reduce any worries or fears that students may have around traversing the campus, especially since the reduction of physical open days and reduced access to the campus. Other parts of the game provide information to the player, as mentioned in Section 3, such as using space to depict a miniature virtual open day. This could be a valuable feature for prospective overseas students who would otherwise be unable to see the campus, as these individuals could immerse themselves within the virtual campus while learning about the many courses offered at the university. The categorisation of Lincoln Island as a Transitional Games illustrates how a virtual environment may be utilised to help students transition to university and how game design features can be used to indirectly teach individuals of information in an enjoyable and engaging setting.

3. Design

When we first instigated the project, we defined a number of design rules to guide development. The first was that all key buildings, campus features, and navigation routes should be in the same position on the virtual map as they were in the real world. Secondly, all the buildings would be re-imagined to be consistent with a specific fantasy setting but should be recognisable. We decided to re-imagine the island for three reasons. Firstly, for accessibility reasons, we wanted to move to a low-poly implementation; that aesthetic would not have suited a realistic presentation. The second reason was that this allowed us to focus on the key features of the campus without needing to recreate every detail. The final reason was that we wanted this to be seen as a game and have some perceptual distance from the real world. However, while re-imagining, we still decided that the scale of the environment and the navigational experience (how long it takes and the route you take to walk from location A to location B) should be the same.

We picked a Pirate Island as our fantasy setting, as this had a number of advantages. The first was purely practical, namely that thousands of commercially available high-quality 3D assets were available for this theme; using these pre-developed assets allowed us to develop the environment rapidly. Secondly, by using an island as a setting, we could justify the world boundary (namely the edge of the campus) within an in-game narrative. The development process for building the island is detailed in Figure 1. We started by taking an aerial photo of the campus and roughly cutting this into an island shape. We did this by simply following the natural campus boundaries (specifically roads and the Brayford Pool lake). We then converted this rough shape into a vector and applied smoothing, and used photos of real-world islands to inspire a beach boundary. This vector was imported into a 3D modelling package to produce the land-mass model. Finally, we also placed placeholder buildings and path networks using a combination of the aerial photo and map data. These placeholders were subsequently replaced during the environmental design phase with the final models.

To further maintain the experience, we decided to implement a day-night cycle in the environment system. In this system, the in-game clock is synchronised with the time in the town of Lincoln, so when it is night (and dark) on the actual campus, it is nighttime on Lincoln island (and vice versa).

Figure 2: *The top image is of the Lincoln Delph Pond and Issac Newton building. The bottom image is taken from TULI, the virtual counterpart.*

3.1. Creative Interpretation

A large part of the environmental design work involved selecting a building or an environmental feature and determining how that could be 're-imagined' to match the narrative theme of the new environment. An example of this can be seen in Figure 2 where the Issac Newton building and Delph pond hand been redesigned into Lincoln Island.

Figure 3: *The Lincoln Island train.*

However, certain important features of the University of Lincoln campus did not suit our pirate island theme. For example, the actual campus is split down its length by a railway line. We wanted to keep this railway, as traversing it (over bridges or via the level-crossing) is part of the navigational experience of the campus. However, in reality, the railway line runs beyond the boundary of the campus, which did not suit our island design. Our solution was to wrap the railway back around then it reached the boundary; we then made it follow the coast, connecting as a loop. This element allowed us to maintain the navigational feature while maintaining the island's design. Also, by running the track around the coast, we did not add

any additional navigational consideration to the player (remaining on the actual campus experience). As a bonus, we decided to use this train as a way to give the player an overview of the environment, a narrative-based fly-by camera (see figure 3).

The campus is also bisected along its short length by a flyover road which (combined with the train) essentially splits the campus into quadrants. However, a flyover did not suit the theme, so this was redesigned as a '*natural*' crag, splitting the island. We included the same tunnels and pathways, maintaining the navigational experience while working within our narrative theme.

3.2. Utilising Space

A university campus has many open spaces that do not translate well into a video game setting (such as car parks). From a visual perspective, this can make an environment feel empty; furthermore, it is hard to justify (from a computational cost perspective) the inclusion of space that has little to no impact on the player. We chose to utilise these spaces as additional features. The university has (on occasion) used these open spaces for pop-up exhibitions, theatres, food festivals, and student fairs, so we decided to set them up so that they could be used similarly in the virtual environment. An example can be seen in Figure 4.

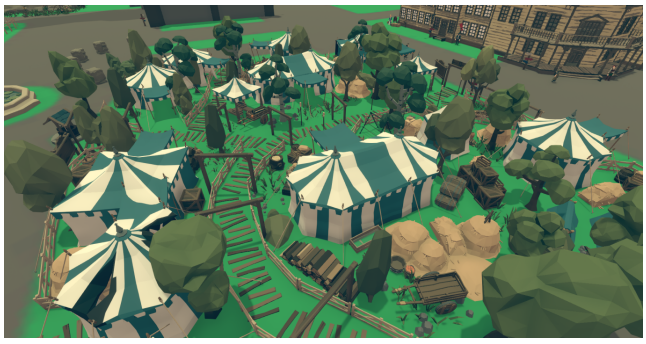

Figure 4: *An exhibition space in the Lincoln Island game.*

Setting up the space in this way has provided us with the opportunity to situate some of normal our outreach and public engagement activities into the virtual world.

3.3. Non-Player Characters (NPCs)

We populated the environment with a number of non-player characters (NPC) - A character controlled by Artificial Intelligence (AI). NPCs gave the environment a natural feeling of activity and life. We made the design decision to crowdsource the NPCs from genuine staff and students. A survey allowed individuals to design their NPC, including giving them a name and deciding on their representation. Furthermore, they could provide their character with some elements of dialogue; this content included everything from study tips to guidance for new students. The intention is to give players an understanding of the university's ethos and learning community. The environment now has over 50 staff NPC representations and 80 students.

Figure 5: *A staff NPC, currently issuing quests (as highlighted by the exclamation mark above their head)*

NPCs also act to guide the player through the issuing of quests. This is illustrated in Figure 5, where a staff NPC has a quest available for the player (highlighted by the exclamation mark above their head). This is further discussed in section 5.1.

4. Technical Challenges

The TULI project was built using the Unity3D game engine, partly due to its rapid development environment, multi-platform support and its in-built collaboration tools. In addition, we targeted the Universal Windows Platform (UWP) for release, as it a) represents a diverse range of Windows-based devices and b) enables the easy deployment of the final game via the Microsoft store. Throughout development, several notable technical challenges were overcome.

4.1. Platform Independence

One technical challenge we faced through development was optimising the game for platform independence. Unlike console deployment, targetting desktop development requires additional consideration of player hardware limitations. Two players of the game may have very different hardware setups and two potentially different game experiences. For this reason, several steps were taken to optimise the final game and ensure a consistent experience regardless of platform or hardware capabilities.

The first solution employed to mitigate this issue was through an area-based occlusion culling approach. Instead of rendering the entire scene, occlusion culling limits draw calls exclusively to meshes within the player's view at any one time. This was done by initially testing if objects reside inside the view frustum of the virtual camera. Our occlusion culling method follows the same approach whilst also using delimited areas throughout the map to further reduce the number of overall tests. We also reduced the far-clipping plane distance of the virtual camera, removing the requirement to draw objects far from the player. Utilising an occlusion culling approach resulted in considerably higher frames-per-second (FPS) with less jitter.

Another similar issue we faced was FPS fluctuation, especially concerning dense areas of objects. In particular, FPS could quickly and quite significantly drop whilst viewing dense clusters of objects

within the virtual world. This was primarily an issue given that the TULI virtual world is detailed with several areas of densely distributed objects (such as forests, shrubbery, and cobbles). Whilst occlusion culling removes the need to render assets within the virtual environment globally; it does not account for considerable numbers of local objects within the view frustum. However, this issue was primarily circumvented by a level-of-detail (LOD) approach, reducing the fidelity of meshes based on player proximity. Furthermore, additional components (such as colliders or scripts) were also enabled or disabled depending on proximity to reduce overhead. These steps resulted in considerably less FPS jitter and a smoother game-play experience.

4.2. Future Proofing

Another area that proved challenging was developing the game so that it could be expanded in future developments. For example, one area we wish to explore in future releases is multiplayer capability. We, therefore, developed the existing code-base in such a way to enable multiplayer capabilities easily. This was also the case with in-game scripts, such as mini-games, NPC dialogue and quests. In particular, the scripts were developed and integrated into the game with extensibility in mind, allowing for future content to be easily created.

Furthermore, while we have not implemented Virtual Reality (VR) options, we recognise the benefit of exploring an environment in this format. Virtual Reality would allow users to better understand the layout of the campus by putting them in a real-world perspective. It is also becoming more ubiquitous as a technology, with high quality and low-cost consumer-level devices now available (such as the Oculus Quest). Therefore, we have developed the player controller to rapidly adopt VR movement best-practices [ACH18]. Furthermore, the low-poly style of the game would also suit the rendering capacity of a VR device.

5. Gamification

At its core, Lincoln Island is a campus simulation designed to help new students learn the environment. We used two primary gamification strategies to support and encourage exploration to support this goal.

5.1. Quests

Quests are a common feature of role-playing videos games. They are tasks that a player can undertake, usually in order to gain some reward. In the current version of Lincoln Island, we have included a number of quests in the form of scavenger hunt exercises. These quests are issued by NPCs in the game and are designed to encourage the exploration of specific areas. For example, the game includes one quest where students are encouraged to find the locations of the various support teams (such as the well-being team and advice service) on the campus.

5.2. Mini-Games

Beyond the core quests, mini-games are often included in role-playing games. These help to maintain player engagement and provide enjoyable breaks from the core gameplay loop. We identified

Figure 6: *The 'cannon target practice' mini-game included in the first version of Lincoln Island. Players compete to hit all the targets in the shortest amount of time.*

(through testing) that mini-games could help us to further encourage player exploration of the island. By scattering these engagements throughout the map and not promoting their availability, the player is rewarded for exploring. Once they have found the first mini-game, they are encouraged to find if there are others. We can also use mini-games to provide learning content to the player. Another advantage is that we can use mini-games to provide social opportunities within the island. We are currently implementing multiplayer functions that will allow the player to compete with their friends. We currently have one mini-game built into Lincoln Island, namely a cannon target practice mini-game (see Figure 6, the intention is to release additional mini-games through subsequent updates.

6. Evaluation Strategy

Lincoln Island is an exploration game available for anyone to obtain and play. However, the initial testing phase will invite any University of Lincoln student who has used the game to complete various surveys concerning the effect the environment has had on them. Participants will be asked to complete a State-Trait Anxiety Inventory (STAI) and a Positive and Negative Affect Schedule (PANAS) to determine an average anxiety baseline. Data will also be collected on students' attitudes regarding the transition to university, whether their prospective leans towards a more positive or negative outlook. The STAI is a 40-question self-report psychological assessment based on a 4-point Likert scale. The STAI assesses two forms of anxiety: state anxiety, or anxiety over an event, and trait anxiety, or anxiety level as a personal attribute [Til08]. In contrast, the PANAS is a self-report questionnaire with two 10-item measures to assess both positive and negative affect. Each item is scored on a 5-point scale ranging from 1 (not at all) to 5 (very much) [CH04]. Qualitative data will also be collected in the form of another short survey, which will ask participants their views about the transition to university in an open-ended questionnaire.

Secondary testing of Lincoln Island will begin when students return to the university. Students who have not used the game will be recruited to participate as a control group. The participants will be divided into either those that have access to Lincoln Island as the experimental condition group. Or those who do not have access

to the game, as the control condition group. The variables are then controlled within the test; this measures how efficacious the experimental group is. Participants will then complete the STAI and PANAS questionnaire to indicate their pre-test anxiety levels as a baseline before they split into their respective groups. The experimental condition group will play the game for 30 minutes each day for a week, or until they have played the game seven times. So, the individuals can get accustomed to the game and have enough time to explore and learn the environment.

After a week of the experimental group playing the game, both groups will partake in their post-test assessments. The assessment includes completing the STAI and PANAS questionnaires to determine their post-test anxiety level that can be used to compare the results from their pre-test assessment. Additionally, comparisons will be made between the experimental and controlled groups to evaluate which group had a better effect on reducing anxiety.

Next, the usability of the games is measured using a System Usability Scale. The questionnaire will be given to the participants to determine the ease of use of the system. A high level of usability shows that the system can be successfully used and allows users to complete tasks efficiently. Furthermore, additional qualitative data will be collected. Specific questions into how utilising the game, or not, has affected their anxiety and their views around traversing the campus. Therefore, a comparison of views can be evaluated to discover if participant opinions have changed about travelling around the university.

The follow-up assessment will be conducted three months (December/January) after the initial assessment. A similar process to the pre and post-test assessment will be followed in order to obtain further results. These results can be used to compare anxiety levels and views (pre-test, post-test and follow-up assessment). A more definitive assessment of whether utilising Lincoln Island has reduced anxiety for students by collecting further results. If results show that the levels of anxiety decreases (within the experimental group), this should result in students being more confident about directing themselves around the campus and should improve their quality of life within the university.

7. Conclusions

In this paper, we have presented the Lincoln Island project, a work-in-progress recreation of the University of Lincoln Campus. This paper has been written as a case study, describing one of our efforts to respond to the COVID crisis. It is presented to the community to start a dialogue about how games could support social distancing while supporting new students with their transition to university. Specifically, we hope that the insights we have gained during the development of this Virtual Environment could be of use to other researchers and educators looking to make similar accommodations. While we do this initially in response to the global pandemic, we also believe that environments like these could be used as part of a suite of strategies to support students transitioning to university. The move to university may be viewed as a difficult time period, with a higher level of psychological distress being observed within first-year students following the university transition [FH87]. To address this, we believed that a game environment, with its engaging and dynamic characteristics, may be a helpful aid in alleviating the issues caused by the transition. In the same way that serious games have shown efficacy for supporting learning environments.

A significant body of work was put into areas like this around 10 years ago through the Second-Life platform, but recent progress has been slow and quick to adapt to new technologies. We hope that this work will help start a conversation about how this pedagogic and pastoral support avenue could be proactively moved forward.

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