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CumbræCraft: A Virtual Environment for Teaching Cultural Heritage to Primary Schoolchildren

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Abstract: Game-based learning is a research area that has grown within the past two decades, with evidence of tailoring commercial-off-the-shelf gaming, developing bespoke educational games, and using gamification-based learning tools in a variety of educational settings. However, the Covid-19 pandemic has accelerated the need to focus on virtual learning experiences that are engaging and motivating for schoolchildren to participate in as they face learning from home. Games are one such method of virtual learning experiences that aim to provide a stimulating experience for young people to continue their compulsory education. This paper introduces a project developed between Millport Conservation Area Regeneration Scheme (CARS) and a small team of game development students and academics from Abertay University. The purpose of the project was to develop a *Minecraft Education* world that could be used by teachers to engage primary schoolchildren in the history and heritage of the Isle of Cumbræ, an island in North Ayrshire, western Scotland. The project also set out to achieve aims of promoting local heritage and heritage tourism, enhancing national educational standards, serving as an electronic record of local heritage, and introducing potential career options in gaming to young people. The result - *CumbræCraft* - is a suite of eight lessons that support teachers to use the game within the classroom as a way of teaching young people about local heritage and culture. The world focused on recreating locations and events from the Isle of Cumbræ to present interesting facts and knowledge to pupils in an interactive and enjoyable manner, focusing on interactions of exploration and discovery, narrative and communication, fellowship and teamwork, expression and creativity, and challenge-based learning. The aim of this paper is to present a case study on the design and development of *CumbræCraft* as an educational environment to teach the heritage and history of island communities in western Scotland. Additionally, the paper spotlights a gap for games to be used to teach young people about local heritage and the historical significance of their communities and culture, with a particular emphasis on Scottish culture, language, and tradition.

Keywords: game-based learning, game design, cultural heritage, Minecraft, school curriculum

1. Introduction

Millport Conservation Area Regeneration Scheme (CARS) is a grant programme which funds regeneration and conservation initiatives to reinvigorate Millport as a seaside and island destination. It also aims to boost civic pride by contributing towards social and economic regeneration through outreach activities, in addition to physical improvements to build fabric. The outreach programme utilises the existing Cumbræ Heritage Trail and includes Millport Heritage Cycle summer event open for public and a series of heritage-led workshops for schoolchildren, designed initially to include archive research, photography, architectural sketching, film, gaming and storytelling, and Minecraft. The Covid-19 pandemic resulted in the suspension of a series of planned face-to-face workshops in schools, and an online alternative was focused on. This paper presents a design case study of a virtual world to be used in primary schools to teach pupils about the history and heritage of the Isle of Cumbræ. The aim was to develop educational lessons that would support Millport CARS to engage with primary schoolchildren online using video games. It also aims to address a gap in teaching young people about local heritage, with a particular emphasis on Scottish culture, language, and tradition and raise awareness of ongoing conservation activities and importance of building conservation.

2. Literature Review

2.1 Cultural Heritage and Digital Tourism

Tourism plays a key role in supporting communities within Scotland, particularly those in rural areas through the provision of jobs, economic growth as well as encouraging support of Scottish culture and arts (Gov.Scot, 2018). It was noted that tourism has been shaped by 'Transformational Tourism', which sees tourists desiring more meaningful engagement with the culture and heritage of the destination (VisitScotland, 2020). It is predicted that, by 2030, digital and technological influence will continue to play a major role within this sector

(VisitScotland, 2020). This is one of four “mega trends” which have been identified to be impactful to Scottish tourism (Scottish Enterprise, 2018).

Heritage was also identified as a main strength of local tourism offered by North Ayrshire Council from their Tourism Action Plan, ‘Making Waves in North Ayrshire’ (2018). Heritage preservation has seen a rise in digital trends which has allowed the public to engage with materials and environments that may otherwise be inaccessible. Projects such as *Am Baile*, an online digital archive of the history and culture of Scottish Highlands and Island (High Life Highland, 2020) and the Rijksmuseum’s recreation of the voice of Dutch artist Rembrandt to narrate a series of painting tutorials (Herring, 2019) make use of digital technologies to preserve heritage artifacts while allowing the public to engage with materials online. This method has also been adapted to allow users to explore a wider area such as the recreation of the Cairngorms (Cairngorms National Park Authority, 2021).

Virtual environments generated in response to cultural heritage are often designed towards recreating specific locations, with accuracy to space and objects to support learning (Mortara, Catalano and Bellotti 2013). However, this has not always been the most successful method of delivery of information, where a balance of realism and interactivity is needed (Champion, 2004). McGonigal (2011) discusses that this is primarily due to digital natives’ exposure to virtual worlds from a young age generates a level of expectation of engagement. As a result, interactive game-based learning methods are becoming more prominent with the creation of virtual worlds to contribute towards historical engagement and the preservation of intangible cultural heritage artifacts (Cosovic and Ramic-Brkic, 2019).

2.2 Games and Education

Educators continue to explore novel and innovative ways to use existing commercial-off-the-shelf (COTS) games to improve upon the learning experience for learners (Martí-Parreno, Galbis-Cordova and Miquel-Romero, 2017). Ubisoft have harnessed their *Assassin’s Creed* franchise to provide a guided tour of historical locations such as Ancient Greece and Egypt (Kunze, 2019). *SimCityEDU* adapted Electronic Arts’ city-building simulation game to frame learning challenges for school children around environmental health and urban development (Ellers, 2014). *Minecraft Education* is arguably the most-popular and most-used digital game for teaching and learning, with a large database of online, readily available materials (Kuhn, 2018) and recorded learning benefits (Petrov 2014; Nebel, Schneider and Rey 2016; Karsenti and Bugmann, 2017).

Within a formal educational setting, video games have shown a range of benefits to the learning process such as enhanced student engagement (Reinders 2012) and ‘immersion’ in the learning process (James and Brookfield, 2014) to developing literacy skills (Picton, Clark and Judge, 2020). However, while games possess the capabilities to reform and help bolster players’ engagement with learning materials, the existing approach to developing educational games requires deeper consideration. Isbister suggests that there are two main qualities which make games distinctive from other forms of media – “choice and flow (p. 18) – which allows players to engage with learning materials in deeper and more meaningful ways.

Choice allows players to have control with an activity, stimulating engagement and motivation by requiring players to comprehend and reflect upon situations within the game world (Garris, Ahlers and Driskell, 2002). Flow takes into considerations the players’ emotional and mental investment with a task, characterising the concentration levels of an individual undertaking a task (Csikszentmihalyi, 1975). These concepts can be taken into a meaningful game-based learning format which is conducive to overall improvements in learner engagement (Mortara et al., 2013).

3. Methods

The research followed a practice-based approach to developing a virtual world in *Minecraft Education*. *Minecraft Education* has a well-established community and library of content which has been used within educational contexts for developing subject knowledge (Ming, 2020), fostering engagement through motivation (Dezuanni and O’Mara, 2017), harnessing creative thinking (Cudjikova, 2019), and stimulating collaborative learning (Davis, Boss and Meas, 2018). *Minecraft Education* has been used in various Scottish contexts like hosting a large architectural lesson (Peakin, 2017) and exploring the history of the Transatlantic Slave Trade (O’Sullivan, 2017).

From September 2020 to January 2021, a three-person student team worked part-time during their studies to develop the virtual world. The development followed an agile method of planning, executing and evaluating

(Keith, 2010) with academic supervisors and the client partner in fortnightly increments. A case study approach was taken to explain the design intentions of the developed virtual world. The case study also includes alignment with the Curriculum for Excellence, the national educational framework for Scotland (Education Scotland, 2013). It utilises the taxonomical MDA Framework (Hunicke, LeBlanc and Zubek, 2004) to analyse the types of play experiences that contribute towards learning. In total, five aesthetics of play were identified: Discovery, Narrative, Fellowship, Expression, and Challenge. These aesthetics were selected based on their appropriate alignment to learning objectives (Arnab et al., 2014).

4. Results

4.1 *CumbræCraft*



Figure 1: *CumbræCraft*.

CumbræCraft (Figure 1) is a virtual representation of the Isle of Cumbræ, an island within North Ayrshire, Scotland. The virtual world recreates various historical landmarks and periods to engage school pupils in historical events, culture and tradition, and the significance of Scotland's island communities. By utilising skills such as building, exploring, deciphering, note-taking, and collaboration, pupils engage with the history of the Isle of Cumbræ through constructivist learning (Vygotsky, 1978). *CumbræCraft* comprises of eight lessons related to the island's local heritage and culture:

- *Orienteering* introduces students to the island and its landmarks through guided navigation;
- *Vikings* is a construction-based lesson which captures the history of the Viking conquest and its impact on Scotland's island communities;
- *Garrison House* is a narrative-based lesson which chronicles the various uses, degradation, and revitalisation over two centuries;
- *Medieval Kirkton* spotlights life in the medieval village that existed on the island;
- *Marine Station* is an exploratory lesson where pupils learn about current aquatic research and conservation activities;
- *Cathedral* is a build-based lesson surrounding the history and architecture of the Cathedral of the Isles;
- *Snake Hunt* is a quiz-based discovery challenge based on the legend of St Mirin;
- *Riddle Me This* is a final navigational exercise that tests the pupil's developed knowledge of the island through a series of riddles.

The lessons align with the Experiences and Outcomes listed within the Curriculum for Excellence (Table 1). *CumbræCraft* fits principally within the 'Social Studies' curriculum area which focuses on developing an appreciation of local and national heritage, understanding human activity and achievements, and linking situated events to time and place (Education Scotland, 2013). Alignment with the Curriculum for Excellence suggests the virtual world is intended for 'Second Level' education – coinciding with late-stage primary education aged 8-12 – and develops skills such as observation, curiosity, problem-solving, critical thinking, map-reading, interpretation, and chronological awareness.

Table 1: Alignment of *CumbræCraft* learning activities to Curriculum for Excellence.

CfE Code	Experiences and Outcomes	<i>CumbræCraft</i> Example	Observed Aesthetic(s)
SOC 2-02a	I can interpret historical evidence from a range of periods to help build a picture of Scotland’s heritage and my sense of chronology.	<i>Vikings</i>	Narrative Challenge Fellowship Expression
SOC 2-03a	I can investigate a Scottish historical theme to discover how past events or the actions of individuals or groups have shaped Scottish society.	<i>Marine Station</i>	Discovery Challenge
SOC 2-04a	I can compare and contrast a society in the past with my own and contribute to a discussion of the similarities and differences.	<i>Kirkton</i>	Discovery Fellowship Challenge Expression
SOC 2-06a	I can discuss why people and events from a particular time in the past were important, placing them within a historical sequence.	<i>Garrison House</i>	Discovery Narrative Challenge
SOC 2-10a	Having explored my local area, I can present information on different places to live, work and relax and interesting places to visit.	<i>Orienteering</i>	Discovery Expression Challenge

4.2 Discovery

Discovery relates to play experiences that revolve around uncovering new knowledge and experiences. Discovery-based learning is categorised by exposing learners to questions, prompts, and routes of enquiry that encourages exploration and sense-making under the guidance of a tutor (Hammer, 1997). Within a game-based learning context, Gee (2007) describes the “Discovery Principle” (p. 142) as a link between instructional design and the affordance of space for the player to make discoveries within the game. Incorporating mechanics and systems of self-directed understanding is intended to encourage learners to feel motivated in the pursuit of assimilating knowledge (Litman, 2005).

Activities based on the principle of *Discovery* include *Marine Station*, a level based on the research and conservation work conducted at FSC Millport. The player is guided to explore a variety of the facilities available at FSC Millport, such as a laboratory and library, and make written records of what each of these facilities are used for. This activity takes the form of a tour through the virtual recreation of the aquarium at FSC Millport (Figure 2) and presents questions such as understanding behaviour patterns of salmon and the characteristics of Scotland’s coral reefs. This lesson on marine conservation relates to the learning outcomes from the Curriculum for Excellence surrounding the investigation and understanding of ways in which groups have shaped Scotland’s society (Education Scotland, 2013).

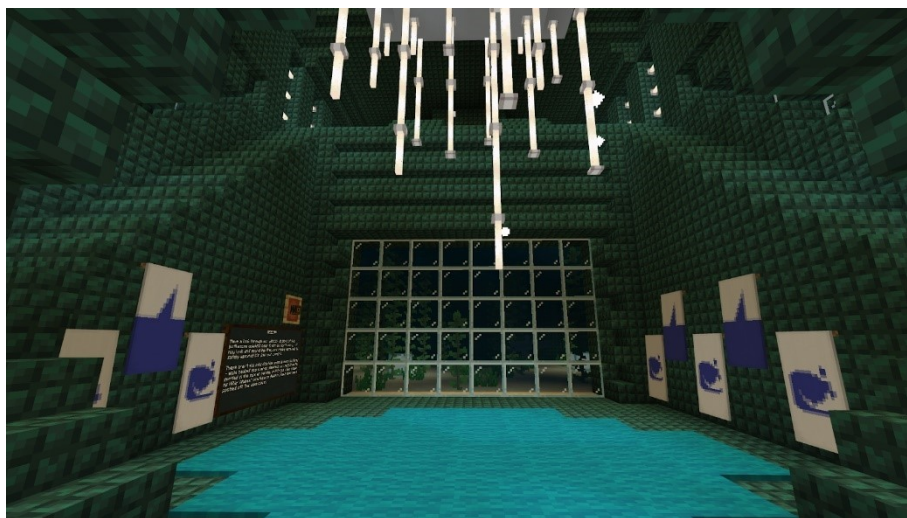


Figure 2: Aquarium in *CumbræCraft*

4.3 Narrative

Narrative pertains to the prominent use of story to communicate learning content. The use of narrative elements in the design and application of game-based learning principles is widely applied (Lester et al., 2014; Ruan et al., 2020; Malegiannaki, Daradoumis and Retalis, 2020). While there is a dichotomy of outcomes from narrative-based learning in games (McQuiggan et al., 2008; Dickey, 2011; Adams et al., 2012), ‘narrative-centred learning environments’ (Rowe, Mott and Lester, 2012) present characteristics for stimulating learning such as participatory learning (Lawrence and Paige, 2016) and developing identity and empathy (Hibbin, 2016).



Figure 3: Garrison House in *CumbraeCraft*

One lesson with a particular emphasis on narrative-centred learning centres on Garrison House (Figure 3). The lesson chronicles the evolving use of the Gothic Revival building at key dates over two centuries, from its initial purpose of preventing smugglers from trading in Scotland, to the restoration of the building as a present-day community hub. The lesson has a virtual tour guide who walks the player through each critical moment in the building’s history. Pupils are required to write down each important event next to the corresponding date, and on completion of the task the pupil will have created a chronology of the building’s uses and functions. This narrative-focused task complements the outcomes from the Curriculum for Excellence related to situating historical events in sequence and understanding the significance of such events at the time (Education Scotland, 2013).

4.4 Fellowship

Fellowship encompasses a social framework that underpins the learning experience. Bandura (1977) defines this as ‘social cognitive theory’ where an individual learns from other through interactions and observations within a given environment. ‘Collaborative learning’ (Bruffee, 1984) exhibits inherent characteristics of community that contribute towards the learning experience. Collaboration in game has suggested a positive influence on encouraging experimentation and constructing conclusions (Saab, van Joolingen and van Hout-Wolters, 2005), cultivating interdependent learning (Romero et al. 2012) and improving overall attitudes and motivation to learning (Sung and Hwang, 2013).

The Medieval Kirkton lesson (Figure 4) presents a collaborative learning activity which requires pupils to build their own medieval village. The pupil is introduced to Kirkton, a medieval village that existed on the Isle of Cumbrae. Pupils develop an understanding of the history of the village through stories from various townsfolk. Pupils then work in groups to create various commercial, residential, and spiritual buildings using the creative tools within the virtual world. Pupils are expected to share insights that they learned from the townsfolk, generate ideas for the presentation and functionality of each building, and construct a representation of a specific building. The recreation of the village serves as a discussion point for the class to discuss their understanding about medieval life in Scotland’s island communities, and to compare to the living conditions of the present day. This is closely associated to the outcome of comparing and contrasting societies in history to modern-day living (Education Scotland, 2013).



Figure 4: Medieval Kirkton in *CumbraeCraft*

4.5 Expression

Expression describes play and learning activities that allow pupils to assert their creativity in the virtual world. Creativity in learning fosters individuality, metacognitive engagement, and self-efficacy (Mayer, 1989; Fasko Jr., 2001; Fautley and Savage, 2007). Behnamnia et al. (2020) present a review of studies which suggest the positive benefits and effectiveness of creativity-centred game-based learning activities, such as acquiring knowledge, stimulating creative thinking, and promoting an explorative approach to complex problems.

Activities pertaining to *Expression* include Vikings (Figure 5), a re-telling of the final attempted Norse invasion of Scotland. After collating a scrambled account of the 13th century events, pupils are tasked with building a fleet of Viking longships reminiscent of King Haakon IV's fleet. Pupils recreate the characteristics of a Viking longship such as the decorative hull, imposing bow and stern designs, and woven cloth sails. Pupils are provided with a template to work from but are encouraged to deviate using their creativity. Instruments such as the Torrance Tests of Creative Thinking (Torrance, 1998) can be used to assess the learner's understanding of the subject matter. This activity is intended to incorporate creativity in the learning of time periods and the chronology of Scotland's heritage (Education Scotland, 2013).



Figure 5: Viking longships in *CumbraeCraft*

4.6 Challenge

Challenge concerns the various obstacles, puzzles, and win-loss conditions present within a game that combine to create a scale of difficulty and skill demands, two key components to 'flow' (Csikszentmihalyi, 1975). Game-based learning environments generate flow through the design of challenging activities, goals, feedback loops, and reward systems (Kiili, 2005). The principles of flow evoke feelings of telepresence (Faioli et al., 2013),

satisfaction and enjoyment (Hung, Sun and Yu, 2015), and self-efficacy (Pavlas et al., 2010) which are indicative of engagement.



Figure 6: Players explore *CumbraeCraft* to locate landmarks

The Orienteering lesson challenges the learner to navigate the island and identify points-of-interest (Figure 6). This initial challenge is designed to familiarise the player with two aspects of *CumbraeCraft*. Firstly, the lesson has an introductory level of challenge in which the learner is required to use basic spatial awareness and observation skills. Secondly, the lesson sets the expectations for the learner to engage with both the virtual world and a short workbook for reading instructions, making notes, and cataloguing progress. The lesson tasks learners to think about landmarks and attractions within the island that can later be used to discuss the site's significance and importance to the local community. This serves to reflect the learning experience of locating places of interest to heritage, tourism, and culture (Education Scotland, 2013).

5. Discussion

This paper serves as a case study on the educational design of *CumbraeCraft* at a conceptual level, yet much evaluative work is required to assess its efficacy in teaching local heritage and culture to primary schoolchildren. A pilot study – commenced in May 2021 – will shift the focus towards evaluating its value for heritage-based engagement and measurable learning. The study will evaluate the suitability of *CumbraeCraft* as a learning tool in line with the Curriculum for Excellence.

This paper has focused more acutely on the design and development of educational content. The design had to contend with the objectives of Millport CARS while retain direct connection to the curriculum. What emerged was a playful environment focused on five play aesthetics for exploring the history and heritage of the Isle of Cumbrae. *Minecraft Education*, as a sandbox game, allowed the design to connect with a broad range of subjects through the lens of local heritage and history. The lessons reflect topics that teachers can use to foster community learning and development, using key elements of the Social Sciences curriculum to enhance core skills around literacy and numeracy.

CumbraeCraft serves two additional goals beyond education. Firstly, *CumbraeCraft* is an electronic record of local heritage, aligning with the goal of Millport CARS in (digital) conservation. Secondly, *CumbraeCraft* supports regional goals derived from the Scottish Government's Developing the Young Workforce strategy (Scottish Government 2014) by engaging young people in real-life contexts and presenting possible career opportunities. Through engaging with *CumbraeCraft*, the long-term ambition is to inspire young people to consider career options in digital and creative sectors.

6. Conclusion

In this paper, we have discussed the design and development of *CumbraeCraft*, a virtual world within *Minecraft Education* to support the outreach activities of Millport CARS. A suite of lessons was developed, providing 'Second Stage' primary schoolchildren with a virtual environment to learn about the heritage and history of island communities in western Scotland. *CumbraeCraft* serves as a novel approach to promoting local heritage

and engaging young audiences in local historical events. *CumbræCraft* was developed to provide an educational experience that meets various learning outcomes within the Curriculum for Excellence. The paper serves as an explorative case study on the collaborative development of a virtual world for promoting Scottish heritage and culture through game-based learning.

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