



ARTICLE

Digital Games Based Learning for History – Problem Solving or Problematic?

Katrina Foy, kfoy@abdn.ac.uk

 <https://orcid.org/0000-0002-1789-4536>

University of Aberdeen, Scotland

DOI Number: <https://doi.org/10.26203/m7kg-5j29>

Copyright: © 2021 Foy

To cite this article: Foy, K. (2021). Digital Games Based Learning for History – Problem Solving or Problematic?. *Education in the North*, 28(2) pp. 115-133.



This is an open-access article distributed under the terms of the Creative Commons Attribution-Non-commercial License (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits non-commercial use, distribution, and reproduction in any medium, provided the original author and source are credited.

Digital Games Based Learning for History – Problem Solving or Problematic?

Katrina Foy, kfoy@abdn.ac.uk

University of Aberdeen, Scotland

Abstract

This study follows the design and development of an educational digital game, Tales of Iona, which was designed to be used to promote understanding of the ancient Scottish island of Iona in upper primary or early secondary schools. The game was designed to combine clear pedagogical principles of teaching History with the best of contemporary digital gaming technology. The intention of the game is to engage players in an immersive virtual environment where their interactions with characters, artefacts and historic events through a series of puzzles will develop their understanding of the historical importance of the island of Iona and spark curiosity to learn more about the past. A Design-based Research (DBR) approach was used in this study and the data was collected on a trial day of the prototype of the game. The data was collected from a small sample of players (aged 10-14 years), using methods of questionnaires, interviews and Video Commentary Capture Model (VCCM) to record gameplay and meta-cognition. Analysis of the findings led to improvements to the game design and gave an insight into the way players learn through digital game playing. Conclusions were drawn to the way the game promoted substantive knowledge of the historical context and stimulated further historical enquiry.

Keywords: digital games-based learning, design-based research, history teaching, substantive and procedural historical knowledge

Introduction

This article discusses the very timely topic of digital game-based learning and design which has attracted much interest in recent years. The Covid-19 pandemic has seen an unprecedented move to online learning and the educational marketplace has become flooded with digital based solutions and tools to facilitate remote learning (Teräs, Suoranta et al., 2020). Now more than ever careful consideration needs to be given to the design of tools and artefacts to support digital pedagogies. This paper follows the design and creation of an educational digital game, Tales of Iona, by a team of three educators from the School of Education at the University of Aberdeen in collaboration with the digital game design company Hyper Luminal Ltd. It will examine what players learn from engaging with this bespoke digital game, designed as a didactical tool for teaching history in upper primary and early Secondary school level.



Figure 1: Tales of Iona title page

The Iona Cathedral Trust is a charitable organisation who look after and promote learning about the historic Scottish island of Iona and the ecclesiastical community who have had a presence there since the 6th Century AD. The trust was looking for a way to increase the educational reach of this remote island and sent out a tender for bids to develop an educational website. The design team from the University of Aberdeen successfully put forward an idea to develop an on-line gaming experience to be used in schools.

The development of a game was proposed as an innovative and engaging way to spark interest and understanding of this unique historical context. The design team knew of a growing interest in the use of digital games to enhance learning with development of serious games for learning becoming more established since the millennium (Whitton, 2014). A meta-analysis of Digital Games-based Learning (DGBL) has shown that educational digital games can have an impact on knowledge acquisition/content understanding and motivational outcomes (Hainey, Connolly, et al., 2016). The design team for Tales of Iona felt that a free on-line game that was accessible to schools would be a different way to promote Iona and may have a greater uptake in schools as there was a lack of digital resources to support teaching Scottish history.

The digital game would be a contrast to the traditional approach to teaching history in the classroom which has relied on the use of textbooks. Research by Harris and Haydn (2006) shows the level of interest pupils have in learning history can be related to the approaches used to teach it. The pupils in this study highlighted interactive activities such as role play and debate as being the most interesting and enjoyable to participate in. The use of computers did not feature highly but it is not known if this is due to a limited number of History lessons using this approach at the time this research was conducted. This was also highlighted in a survey of Scottish teachers (Razak, Connolly and Hainey, 2012) who noted that there was a lack of digital resources to support Social Studies (History, Geography and Modern Studies) in schools and teachers rated Social Studies as 6th behind other curricular areas as suitable for games based learning. The design team for Tales of Iona wanted to create a bespoke game

with clear learning objectives which could be used in classrooms to introduce school pupils to the history of the island.

Tales of Iona was designed to engage players by immersing them in an ancient virtual environment. Through interacting with artefacts and characters within the visuals and narrative, players could build an understanding of the historic island. The player would be on a pilgrimage to find a reliquary following a route through the virtual historic landscape of the island in the 8th Century. The gameplay involves solving puzzles and interacting with historic characters for instruction and choices on where to go next within the narrative sequence. Each puzzle scene within the game was themed around an event, artefact or character from the island and players would learn about the past by engaging with these affordances. Information boxes called 'Nuggets' appeared when historic artefacts or characters were clicked on in the game to give the player a deeper understanding of the context. We hoped the game would act as a stimulus and arouse curiosity to find out more about the island away from the game.



Figure 2: One of the structures within the game, a map - to aid navigation within the game

The creation of the game took a Design Based Research (DBR) (Barab and Squire, 2004; Plomp and Nieveen, 2007; Design-Based Research Collective, 2003) approach as this is recognised as a methodology which can empower educators to create bespoke resources and pedagogical approaches tailored to their context (Dede, 2004). This allowed for the systematic research and development through trialling of a prototype, combined with an understanding of relevant literature to influence the creation of the end product. This article focuses on the research which was conducted during the prototype phase where participants learning, engagement and curiosity was examined. Data was gathered during a trial day from participants completing questionnaires, recording of one participant's gameplay and interviews. This data then influenced design modifications and refinement of the game to meet the intended outcomes. This paper examines what the players learn and how engagement with this game can impact on their learning about the history of Iona.

Digital games and learning

Games have always been part of human culture, allowing people to interact, explore, compete and problem solve and as long as there have been games there have also been games designers and players (Whitton, 2010). The development of digital games is the latest manifestation of this cultural phenomenon and although it takes place within a technologically advanced domain, the premise of game play remains largely the same.

Vygotsky (1967) conceptualised play as a cognitive process which allows learners an opportunity to realise behaviours in an imaginary way. Six basic elements of play have been identified by Eberle (2014) which help to give definition to the concept. Anticipation, surprise, pleasure, understanding, strength, and poise can all be observed within a game play experience. Within these elements sits 'understanding' and it is this idea that Gee (2005) categorised as *meaning as action* where learners learn through experiences they have had. Gee takes this further within digital games by highlighting the *Situated Meaning Principle* where the meanings of signs (words, actions, objects, artefacts, symbols, texts, etc.) are situated in embodied contextualised experience. Digital games for learning can therefore have a positive impact on understanding, but Clark, Tanner-Smith and Killingsworth (2016) emphasise the key role the design of the game plays on the overall outcome in terms of learning and engagement. Games designers should therefore not be questioning if games are effective vehicles for learning but should be considering improving the way educational games are created, researched, and developed for specific subject areas.

Digital Games and learning History

The Tales of Iona game was intended as a tool which could be used by teachers which was different to the more traditional textbook approach. History is a subject area of much debate over the past two decades (Havekes, Arno-Coppen and Luttenberg, 2012) with a movement away from the pedagogy of teaching historical facts towards pupils being given opportunities to critically analyse, interpret and scrutinise evidence. This was further defined by Seixas, Morton et al. (2013) who highlighted six concepts of historical thinking which include exploration of historical significance, evidence, continuity and change, cause and consequence and perspective. This has led to much debate over the best way to teach history with more scrutiny of the traditional textbook approach. A historical digital game can be seen in the same context as a historical textbook where facts or substantive knowledge is imparted through immersion or exposure to the historical content of the game. Garske (2017) highlights the difficulties in making a connection between substantive and procedural knowledge in educational media concerned with teaching history. McCall (2016) takes this further by showing that the interactive aspects of the digital game can impact on the choices, learning and engagement of the player. This suggests that the goal of historical digital games should not simply be to play but also to promote historical inquiry and analysis. When researching the prototype of the Tales of Iona game the research focused on whether facts about the island (substantive knowledge) can be learned from playing the game and whether playing the game piqued curiosity to enquire further into the subject area.

If educational media is to be developed to support the teaching of History, it must be underpinned with sound learning theory. Bruner's theories on learning (Bruner and Luffburrow, 1963) have had a substantial influence on the way History is taught in schools. Cooper (2013) examined creative ways to teach History and describes contexts in which historical material may be made available to the learners. Cooper advocates the following contexts which are linked to Bruner's learning theories:

- Physical experience (e.g. site visit)
- Visual (pictures, maps, diagrams)
- Symbolic (language).

The design team were aware of this during the creation of Tales of Iona and aimed to create a virtual environment which would give players the opportunity to interact with characters, artefacts and events associated with this ancient context. The player interaction with the affordances in the game can be regarded as learning by 'stealth' (Sharp, 2012; Whitton 2014) where, for example, a player's focus is on solving a puzzle and through interacting with it they also learn about the historical context of the puzzle.

The designers of Tales of Iona realised they would also have to include text on the screen for instructions and further information about the historic structures. This can be seen as one of the drawbacks to engagement in gameplay as players can sometimes not be bothered to read long explanatory texts (Whitton, 2014). This is a characteristic of many game players, and Oblinger and Oblinger (2005) state that an overreliance on text may inhibit participation. This concurs with other studies of virtual environments and games where similar tensions have been observed between



Figure 3: Scene showing the virtual re-imagined environment

language and interaction with the visual environment (Ijaz, Bogdanovych et al., 2017; Bass, 2020). The design team went on to adapt the narrative to give enough reference to the specific historical vocabulary in the onscreen instructions but were conscious of not making it too overt that it interfered with gameplay.

Digital games to engage learners

The developers of serious games must promote a sense of enjoyment for a player to return to a game, but this can sometimes highlight a tension between education and playability. If instructional content is paired with game features such as competition, problem solving and reward, the player will be more motivated to achieve the desired learning and gameplay outcomes. The more a player can become engaged in gameplay, the more the player may learn (Brockmyer, Fox et al., 2009). This feeling of absorption while playing a game is often described as 'flow' (Csikszentmihalyi and Csikszentmihalyi, 1988; Cairns, 2016). Experienced game players have reported a feeling of being fully in control and being at one with the activity (Garris, Ahlers et al., 2002). Designing a game which can engage players to this level, at the same time as achieving a learning objective, is a challenge for designers. As already discussed, the learning may be intrinsic and occur in a 'stealth' like way. Whitton (2014) argues this may occur within all games but there must be time for reflection on knowledge acquired and skills developed if learning is to be maximized and sustained.

Ijaz et al. (2017) study of engagement and learning of history in a virtual reconstruction of the ancient city of Uruk shows that students are more motivated and engaged to learn about the past when a virtual approach is taken. The evidence from players of the Uruk game showed a deeper understanding of the history and lives of the inhabitants of this ancient city than students who had just learned about it from the more traditional approaches. It was the interaction with agents or characters that Ijaz et al. (2017) propose made the experience more impactful in terms of learning history. It also showed that participants are keen and motivated to enter these virtual environments, however, there does need to be verbal and written explanations given within the immersive experience to enable students to develop their knowledge further. Ijaz et al. (2017) also acknowledge that the immersive experience cannot entirely be a substitute for a teacher in the classroom and what is taught outside the virtual environment is important if teachers wish to capitalise on learning.

Curiosity is another aspect which has been highlighted as an outcome derived from the playing of computer games. Razak et al. (2012) state that curiosity and pleasure are two of the reasons stated by Scottish teachers in their survey of the way computer games are used in the classroom. Curiosity can be defined as a gap in knowledge (Lamnina and Chase, 2019). Videogames are designed to be engaging for players (Cairns, 2016), which is often accomplished by stimulating players' curiosity. It is that desire for knowledge which motivates individuals to learn new ideas, eliminate information gaps, and solve intellectual problems which can be particularly potent within a digital game experience (Huck, Day et al., 2020). Curiosity can be part of what propels the player forward and enables achievement within the game through solving puzzles and achieving levels. It can also sit outside the game and be something that sparks interest and motivates the player to find out something more about the stimuli within the game.

From examining the literature on playing digital games it is evident that more consideration is being given to the development of games to promote learning (Whitton, 2014). The emergence of serious games has seen a move away from games being played solely for entertainment to them being used as learning tools in the classroom. The literature reviewed indicates that digital games can have a positive impact on learning, and this can be increased if designers construct affordances within the gameplay to support this. The design of Tales of Iona reflects this with players being given choices and puzzles which promote engagement with historical content.

The research conducted during the prototype phase primarily focused on the following questions:

- What substantive knowledge do players acquire when engaging with a historical digital game?

To influence the design of the game and how it might be used in a classroom a further sub-question was also investigated:

- How does engagement with the structures and affordances within the virtual game environment impact on learning?

Answering these questions would then influence the design of the game to promote understanding of the history of Iona. Ultimately this would lead, through the iterative design process, to the production of

a game which fulfilled specific learning objectives and could also generate advice for teachers on how to optimise the learning when using the game with a class.

Methodology

Why take Design Based Research (DBR) approach?

DBR is particularly suited to design and creation of educational digital games. Having iterative trialling allows for changes and adaptations to be made to structural aspects such as the narrative or sequence of events while the game is still at the prototype stage. Squire (2005) sees DBR as a valuable option for examining educational technology and the impact of digital games-based learning on players. Stating the pragmatic nature of the prototype designs as being particularly suited to the creation of new educational technology. It is the pragmatic nature of the methodology that make it an appropriate paradigm on which to base DBR (Alghamdi and Li, 2013). The design team for Tales of Iona chose this methodology as it allowed changes to be made to the structures and affordances within the game at the trial stage to enable it to become a more effective product meeting its desired outcomes in terms of learning and engagement. For Tales of Iona a trial day was set up where participants could play the game while it was still in the proto-type stage. It was during the trialling of the game that data was gathered which examined the way participants acquire knowledge of the historical context during the playing of the game. Research was also conducted into the stimulation of curiosity during and after gameplay. This paper will only focus on the research conducted during the prototype phase of the DBR cycle.

Participants

Participants in this study were players from the upper-stages primary or early-stages of secondary school (aged 10-14 years), as this fitted with the demographic the game was designed for. The participants did not need to have any prior experience of playing digital games and were invited to attend the trial day, held in a computer suite at the University of Aberdeen during the school summer holiday. The timing of the trial during the holiday period meant the initial request for participants generated interest from only 2 pupils. However, the pupils in turn recruited 3 friends who were able to obtain parental permission to take part in the trial. There are drawbacks to having such a small sample size as the results may not be transferable to the wider population. This 'snowball' sample (Thomas, 2013) was made up of 5 pupils, all male, aged 11 and 12 years old who all knew each other. Thomas (2013) argues that a snowball sample can be an effective way of recruiting participants; and for this project, the fact that the participants were all friends, described themselves as 'gamers' and interested in game design, meant that they were highly motivated to participate in the research process and could give insightful feedback on gameplay. It did, however, mean that the sample size was small, and the data gathered may not be representative of the wider demographic. Each participant was labelled Player A to E.

Ethical Considerations

As data was gathered from a vulnerable group i.e. children, it was important that the BERA (2011) guidelines were followed and informed consent was obtained before the data collection could begin.

This meant obtaining consent from parents. The participants in this study were volunteers and were opting into the research. Both parents and children understood the purposes and processes involved in gathering and interpreting the data and they had the right to withdraw at any time. It was also made clear that the video game had been designed for pupils in the 10-14 age group and the content was appropriate for use in schools. This is a consideration that must be made when researching video games as on-line games only have a voluntary Pan European Game Information (PEGI) rating. The content of the Tales of Iona game would be suitable for all age groups as it contained no sounds or pictures which would be likely to scare or frighten young children.

An additional ethical issue which had to be considered was the dual roles of the researchers also being the game designers. They had a vested interest in the game succeeding; therefore, a conscious effort had to be made to take a neutral stance when analysing data and making improvements to the game design. Participants had to be treated fairly and there were no perceived expectations on the content of their answers.

It was made clear to participants that the data was used to influence improvements in the design of a free on-line game that could be accessed anywhere. There was no commercial gain to be made from the game as it was sponsored by the Iona Cathedral Trust charity and would be free to use on-line.

Methods and structure of the trial day

The study would gather evidence using three data collection tools: questionnaires, video commentary model (VCCM) and a post gameplay interviews. Using these three methods increased confidence in the interpretation of data, which in turn allowed findings to influence improvements to the design of the game. The gathering of data was also sequential in that it looked at the way historical knowledge was developed before, during and after the game was played. On the trial day the questionnaire was completed first and the results were used to determine some of the post-play interview questions that would be used that day. A questionnaire was chosen as a quick and effective way of establishing the participants' prior experience of digital games and learning through this medium (Thomas, 2013). Gathering information on their prior knowledge of the specific historical context of Iona gave a baseline assessment of attitudes and knowledge. Later this was then analysed and compared to data obtained after playing the game from the post-play interviews.

This sequential approach (Creswell, 2007) was appropriate for the trial day as quick analysis of the data was needed to formulate questions for the post gameplay interviews. It was also important for the designers to know if they were observing the play of novice or experienced gamers. This allowed them to gauge the playability of the game.

The Video Commentary Capture Model (VCCM) is a research method which is becoming increasingly used in the usability testing of digital games (Ribbens and Poels, 2009). This method makes a recording of the screen, showing the game scenes and the choices the participant makes as they play the game. A Concurrent Think Aloud (CTA) protocol was also used in this study and the participant (Player A) wore a headset which simultaneously recorded their commentary and the gameplay on the screen (where they clicked on the screen, moved the cursor etc.). On the trial day the researchers only had

one available computer set up with this facility. Player A volunteered to be recorded in this way and was prompted to keep talking out loud about what they were thinking or doing as they played the game. They were also encouraged to talk about their feelings, choices, challenges, and successes during the game trial. However, consideration had to be made on the impact this might have on the player's habits and flow of the game (Ribbens and Poels, 2009). The VCCM player was also interviewed separately after the recording of the gameplay. This was initially because of time constraints during the trial day but also meant that this player's response could not be influenced by the other participants in the group interview. This player was asked the same questions as those asked in the group interview.

A further group interview was conducted immediately after the participants had completed the game trial. For the trial day, a group interview was an efficient method to gather opinion within the time constraints (Thomas, 2013). The group interview took a semi-structured form and the lead researcher asked the participants questions which guided the group discussion.

Data Analysis

The questionnaire responses were categorised into those which generated data about the individuals and their experience of digital games and more open questions provided data on participants' prior understanding of the historical context. The recordings from the VCCM and interviews were transcribed after the trial day. This gave the researcher a greater insight into the context of the spoken words and the emotion attached to them. In the case of the VCCM there was also the video capture of the gameplay which would give additional information to influence the interpretation of the data. A constant comparative method (Thomas, 2013) was used to analyse the transcripts from the VCCM and the interviews. By scrutinising the transcripts multiple times, themes and sub-themes (prior knowledge, substantive historical knowledge of Iona, gameplay and curiosity) began to emerge which could be coded.

Table 1: The themes and sub-themes and the data sets where these emerged

<i>Theme</i>	<i>Sub-theme</i>	<i>Pre- gameplay</i>	<i>Post- gameplay</i>	<i>Examples</i>
Historical learning	Prior knowledge	Questionnaire		"I don't know anything about the island"
	Substantive historical knowledge		VCCM transcript Post-play interviews	"I think the monk is in the abbey" "We learned about monks and how they live"
	Curiosity		VCCM transcript Post-play interviews	"What is through the door?" "I would like to find out more about the island."
Digital Gaming	Prior knowledge	Questionnaire	VCCM transcript Post-play interviews	"I enjoy playing video games" "If I click here, I should be able to go into the church" "I don't like games with too much reading"
	Gameplay		VCCM transcript Post-play interviews	"Let's move the boat here to get it into the bay" "It got easier as I knew what to click on to help me solve the puzzles."

Results

Prior knowledge

The answers given by the participants suggested they had prior understanding of the conventions of gameplay and were familiar with many of the structures and affordances associated with digital games and felt confident about navigating through the virtual domain. All 5 participants indicated that they had played at least 7 hours of video games in the previous week. This digital literacy (Whitton, 2014) was apparent during the trial as the participants were able to navigate to the puzzles and intuitively knew to click on to objects which glowed or follow arrows. The fact that the participants were all experienced gamers might lead to inequity in the analysis of the gameplay and the impact on learning. Whitton (2014) acknowledges that the experience of games is unique to the individual. In the case of Tales of Iona, less experienced game players may have taken longer to learn to play the game and not have time to engage with the historical content.

The questionnaire asked about participants' experience of using digital games in school for learning. The answers showed that a widespread use of games which may reflect the Curriculum for Excellence (CfE) (Scottish Executive, 2004) which promotes the use of digital technologies to support learning and teaching throughout the curriculum. However, it also showed that there was a lack of games being played in humanities subjects in primary schools (the participants had all just completed their final year at primary school). One participant, did however, recall playing a digital game for a History project. This showed again that Tales of Iona may fill a gap in digital resources to support this area of the curriculum. All the participants thought that it is possible to learn by engaging with digital games.

A baseline analysis was needed to gauge the participants' understanding of the historical context in which the Tales of Iona game was set. When asked about prior knowledge of Iona, most participants replied "nothing" and indicated that they had not heard of the island. They did not know the meaning or recognise words such as reliquary, St Columba, pilgrimage.

Gameplay

A transcript was made of the video commentary from Player A and the associated gameplay capture. This gave an indication of how the player interacted with the structures and affordances within the game. Objects which were highlighted and clicked on by the participant were also recorded in brackets on the transcript. The transcript shows the thought processes of Player A and what they noticed within the game.

Table 2: Player A - VCCM extract from transcript during gameplay

<p><i>Ok so I am at St Columba's outlook (reads title on screen) Let's speak to this lady (clicks on character and reads text)so, I must have to capture the thief...how do I move the boat?...I think that is the boat there ...sailing around.....trying to get to the edge I think (clicks instructions again) ok let's stop him here... right, this is hard...</i></p>
--

The participants did state ways in which the game could be improved. Frustration came with not being able to complete puzzles and having to re-read instructions. In the group interview one participant (Player C) thought it was "better to do it yourself" than read instructions. Many of the responses also

indicated that there was too much writing, and this interfered with the playing of the game. One respondent stated that “it would be better to hear the talk rather than read” (Player D).

Substantive historical knowledge

Throughout the commentary from player A, words associated with the history of the island were used (see table 2). Most of these were because the player repeatedly read out the narrative text from the game which contained many of these historical references listed below. The VCCM transcript shows more historical language being used e.g. Saint Columba, Pict, miracle, Martyrs Bay, abbey etc. Much of this was because the participant was initially diligent about reading the narrative which acted as an introduction to each puzzle but as the game progressed there was a tendency for the player to skip this.

This may be because of the Hawthorne effect (Thomas, 2013) in that the participant was keen and eager to be involved in the commentary at the beginning of the trial and therefore, may have put more effort into reading every word of the narrative or instructions. They may have been aware of being recorded and wanted to make a good impression for the researcher. As the gameplay progressed, however, the participant began to skip through the text often clicking through and not reading the narrative. The participant would often return to read instructions when encountering problems solving a puzzle.

The participants show some awareness of the historical context of Iona in the interviews compared to the responses from the pre-play questionnaire. The participants all agreed that they had learned during playing commenting that they had learned about the history of Iona.

Table 3: Extract from group interview transcript

Interviewer	Participant/ Player response
Do you think you have learned anything about History from playing the game?	B- yes about monks and how they lived C- yes D- yes, where it was set – it was long ago, you could see what it looked like. E- yes, I agree.

Player A (VCCM) gave the most detailed answer to this question stating that they have learned “stories” about Iona.

Table 4: Extract from group interview transcript

Interviewer	Participant/ Player response
Can you describe some of the objects or characters you noticed?	C- there was a monk who popped up a lot... D- there was a writing hut... C- there were lots of boats in the puzzles... D- I liked how the campfire looked... E- there were crosses and church buildings
Did you know what everything was, or did you see something – for example the reliquary- did you know what this was – do you know what a reliquary is now? Well yes, it is the box at the end.	B- is it a pattern, patterned objects? C- Is it the thing at the end, what we were looking for? B- I thought it was a treasure chest.

Specific questions were asked to gauge how the players had interacted with the structures within the game. When asked if they had specifically learned about some of the historic objects or picked up any new vocabulary there was a mixed response. Particularly in relation to specific artefacts such as the reliquary. However, the VCCM participant (Player A) was able to use more specific vocabulary and mentioned the word “reliquary” both during gameplay (reading text on the screen) and then when reflecting during the post-gameplay interview.

Table 5: Extract from player A interview transcript

Interviewer	Participant A/ Player A response
Did you know what everything was, or did you see something – for example the reliquary- did you know what this was – do you know what a reliquary is now?	Yes, I knew what things were because it said in the writing on the screen... Yes, you had to look for the relic, reliquary is that right? It looked like the treasure at the end.

Curiosity

There are examples of curiosity within the game and during the commentary from Player A in the VCCM. The player does verbalise some questions relating to objects such as “who is that?” and “is that what I am looking for?” The player appears to be talking to themselves and goes some way to answering this by re-reading the text on screen or interacting with the puzzle. The player also shows curiosity in the way they solve puzzles by trying different strategies for solving puzzles, persevering through trial and error to get to the solution.

When asked if they were curious to learn more about the island all participants agreed but thought that this might be with a teacher in school. Player D had noticed that there were “nuggets” within the game and they “came up when you clicked on it”. Some of the group were unaware or weren’t sure what to do with these and suggested that “a teacher might tell you what to do with it”.

Discussion

The results obtained from the trial day allowed the designers an opportunity to continue with the DBR approach and make modifications to the prototype game and improve both the structures and affordances built into the game. Changes were made to the narrative, structure and opportunities for further learning within the game. One of the main objectives of the trial day, was to explore whether the game fulfilled the learning intentions established by the designers. These were to examine if the game gave players an increased understanding of the historical context of Iona after engaging with the structures and affordances within the game and whether this sparked curiosity to learn more.

In the post-play interview, there is evidence of substantive historical knowledge being acquired from playing the game. This can be seen in the choice of vocabulary used by the participants to describe the context of the game and can recall facts about the island. This is in direct contrast to their pre-game questionnaire where they answered that they knew nothing about the island. After playing the game the players showed substantive historical knowledge of the island and were able to describe some features, referring directly to some of the objects and buildings in the historical virtual environment. Player A also mentioned learning about “stories” and this would support the idea of the construction of knowledge

from being immersed in a virtual environment and learning by interacting with characters and objects (Gee, 2003; Whitton, 2014). The player has a 'presence' (Tamborini and Skalski, 2006; McCall, 2016) and it is from this perspective, of making choices and interacting within the game, which heightens the player's understanding of the context. It would, therefore, seem as the participants interacted with the virtual objects, this increased their awareness of them. This might be regarded as learning by *stealth* (Sharp, 2012; Whitton 2014) as the players were motivated to engage with the virtual historic structures within the affordances of the puzzle solving. There may however be tension between the visual recognition of historical artefacts in the virtual world and a deeper understanding of the purpose and use of the object in the real domain.

The prototype game was designed to have a written narrative on the screen. The analysis of the voiced commentary from Player A influenced the designers to put more emphasis on specific historical vocabulary such as: abbey, reliquary, Saint Columba, manuscript etc. A balance needed to be struck between the amount of written content and playability so that it did not overly detract from the flow of the game for players. However, it may be through fully reading the text, Player A was able to use more appropriate terminology and vocabulary when describing the features and artefacts from the historical context. They were the only participant in the post play interview who used the word "reliquary" whereas one of the other participants referred to it as a "treasure chest". This may be an argument for the continued inclusion of text in educational games.

Players not only gained substantive knowledge of the history of Iona through the virtual objects they interacted with but that they also learned through 'doing' and become 'knowledgeably skilful' (Lave and Wenger (1991) cited in Barab, Hay, et al., 2001) in using their understanding of gameplay to solve the problems within games. The players all agreed that these problems were motivating, and they all showed high levels of engagement to solve these to progress further on their pilgrimage through the game.

This, however, also highlights a limitation of the game based learning approach. The participants were using higher order thinking to solve puzzles within the game. They were not however using the skills associated with the procedural aspect of learning History i.e. methods and skills needed to understand the past or the 'doing' part of historical enquiry (McCall, 2016; Smith, 2016). When designing educational media to teach History, Garske (2017) shows that the link between substantive and procedural knowledge should be considered. The data from the trial day also showed if players wanted to build on the substantive knowledge, they gained from playing the game. 'Nuggets' (objects within the game when clicked on gave a text with historical information) were included so that if a player wanted to find out more about an object, they had an opportunity to within the game. The data highlighted that the 'nuggets' were an affordance recognised by players but not one they always wanted to explore. They tended to click over them. This is one of the tensions created in educational games. Designers



Figure 4: Screenshot showing the labelling of the 'Altar nugget' within the game

want the player to engage with the content but the player, who is more interested in keeping the play progressing, does not want to explore anything which interferes with the flow of play (Whitton, 2014). Van Eck, (2006, p.11) states “good games promote flow, and anything that causes us to “leave” the game world (e.g., errors, puzzles that require irrational solutions) interrupts flow”. This was a design problem that was later overcome by including more detailed information about the ‘nuggets’ in a separate ‘library’ area of the game which could be accessed later and away from the main scenes of the game. A collection mechanism was also built into the game which encourages the player to click on the objects to increase their score. This got over the problem of clicking away but also kept the labelling of the artefact so the player might read the name of the object which could then be investigated later in the library area of the game and in the real classroom. This supports Whitton’s (2010) view of pupils’ learning benefitting from a teacher who facilitates reflection with other players post play. This is a limitation of effectiveness of the game as a teaching tool for learning history. History is a subject based on discourse and the learning within the game only appears to raise an awareness rather than deeper knowledge of the ancient environment and associated artefacts. McCall (2016) then sees it as the role of the teacher to build on and promote further enquiry and analysis of the substantive knowledge acquired through playing the game. The participants in this study were open to the idea of finding out more about the island and felt that the game had been a motivating way to learn.

Conclusion

This study looked at whether a digital game can have an impact on the learning of history for players aged 10-14years old. Conclusions can be drawn that the Tales of Iona game did influence these participants substantive knowledge of the history of the island through the way they interacted with the affordances and structures within the digital game. Limitations can be seen in the way text is included within educational games as players can feel that this interrupts the gameplay. The players were also less inclined to enquire further within the game. If player’s procedural knowledge of history is to be developed, then it is the role of the teacher to build on the facts gained from play and develop further enquiry outside the game. Educators, however, should still regard digital games as useful pedagogic tools that pupils are interested to engage with. Digital games can also be regarded as a motivating alternative to more traditional approaches such as a textbook as they can pique curiosity about the context of the game. Digital games should also be promoted as an effective approach to the teaching of curricular subjects such as History, especially if a virtual environment can be created where the player learns through interacting with the artefacts, characters, and historic events. This may be regarded as learning by ‘stealth’ (Cairns, 2016) but this learning may need to be further consolidated and developed outside the game.

The designers recognised that the game is a tool for teaching the history of the island which supports Gee’s (2003) established view that DGBL is engaging and effective way to learn. However what educators and designers must examine now is the way games can be integrated into the learning process to increase their learning potential. This is something that needs to be done in the future to explore best practice in terms of integrating Tales of Iona into the teaching of History in Scottish schools. With regard to the learning of history, a digital games-based learning experience can introduce the

player to substantive knowledge about the context of the game but to maximise the potential for procedural knowledge to be developed more exploration of what a teacher can do outside the game is needed.

This relates to the final DBR phase which sets out the implementation and establishment of 'design principles' which may be transferred to solutions for other educational problems. This as a flaw in the dissemination of DBR findings in that they stay humble and localised and do not contribute to wider theoretical understanding (McKenney and Reeves, 2013). The limitations and small nature of this study mean that we can only demonstrate impact potential but not genuine impact on practice. The game has yet to be fully examined for educational impact in the classroom.

Tales of Iona is just one of the many educational games that have been deliberately designed for the purpose of education. The Covid-19 pandemic has been the catalyst for the greater move to online learning and DGBL should be an effective approach to engage remote learners. This pedagogical approach may become increasingly embedded in all areas of curriculum, but this will rely on the creation of high-quality games which have clear learning intentions. More research should be done to enable educators to create and use these games to suit learning and teaching needs.

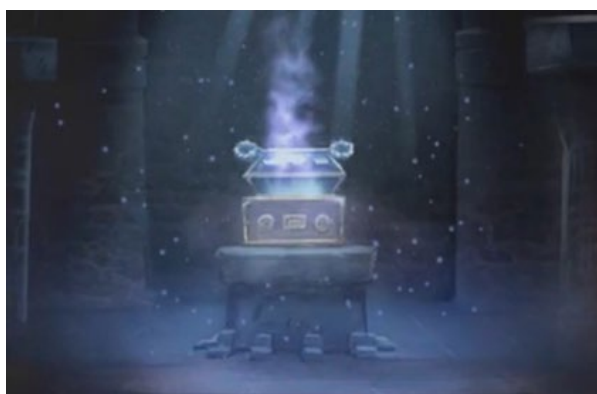


Figure 5: Game over

Acknowledgements and funding

I wish to thank Dr David Smith and Aloyise Mulligan from the School of Education at the University of Aberdeen for their invaluable collaboration as part of design team for Tales of Iona.

References

- ALGHAMDI, A.H. and LI, L., (2013). Adapting design-based research as a research methodology in educational settings. *International Journal of Education and Research*, 1(10), pp.1-12.
- BARAB, S.A., HAY, K.E., BARNETT, M. and SQUIRE, K., (2001). Constructing virtual worlds: Tracing the historical development of learner practices. *Cognition and instruction*, 19(1), pp.47-94.
- BARAB, S. and SQUIRE, K., (2004). Design-based Research: Putting a Stake in the Ground. *Journal of the Learning Sciences*, 13(1), pp.1-14.
- BASS, I., (2020). The Potential of Video Games for Enhancing Teaching History. *International Journal of Management and Applied Research*, 7(3), pp.308-318.
- BRITISH EDUCATIONAL RESEARCH ASSOCIATION, (2011). *BERA Ethical Guidelines: British Educational Research Association Ethical Guidelines for Educational Research*. London: BERA. Available: <https://www.bera.ac.uk/publication/ethical-guidelines-for-educational-research-2011>
- BROCKMYER J.H., FOX C.M, CURTISS, K.A., MCBROOM, E. BURKHART, K.M. and PIDRUZNY, J.N., (2009). The development of the Game Engagement Questionnaire: a measure of engagement in video game-playing. *Journal of Experimental Social Psychology*, 45 pp.624–634
- BRUNER, J.S. and LUFBURROW, R.A., (1963). The process of education. *American Journal of Physics*, 31(6), pp.468-469.
- CAIRNS, P., (2016). Engagement in digital games. In: H. O'BRIEN and P. CAIRNS, eds., *Why Engagement Matters* (pp. 81-104). Cham: Springer. pp.81-104.
- CLARK, D.B., TANNER-SMITH, E.E. and KILLINGSWORTH, S.S., (2016). Digital games, design, and learning: A systematic review and meta-analysis. *Review of Educational Research*, 86(1), pp.79-122.
- COOPER, H. ed., (2013). *Teaching History Creatively*. Abingdon: Routledge.
- CRESWELL, J.W., (2007). *Qualitative inquiry and research design: Choosing among five approaches* (2nd ed.). Thousand Oaks: Sage Publications.
- CSIKSZENTMIHALYI, M. and CSIKSZENTMIHALYI, I.S., eds., (1988). *Optimal Experience: Psychological Studies of Flow in Consciousness*. Cambridge: Cambridge University Press.

DEDE, C., (2004). If design-based research is the answer, what is the question? A commentary on Collins, Joseph, and Bielaczyc; diSessa and Cobb; and Fishman, Marx, Blumenthal, Krajcik, and Soloway in the JLS special issue on design-based research. *The Journal of the Learning Sciences*, **13**(1), pp.105-114.

DESIGN-BASED RESEARCH COLLECTIVE, (2003). Design-based research: An emerging paradigm for educational inquiry. *Educational Researcher*, **32**(1), pp.5-8.

<https://doi.org/10.3102/0013189X032001005>

EBERLE, S.G., (2014). The elements of play: Toward a philosophy and a definition of play. *American Journal of Play*, **6**(2), pp.214-233.

GARRIS, R., AHLERS, R. and DRISKELL, J.E., (2002). Games, motivation and learning: A research and practice model. *Simulation and Gaming*, **33**, pp.441-467.

GARSKE, L.F., (2017). Challenging Substantive Knowledge in Educational Media: A Case Study of German History Textbooks. *Journal of Educational Media, Memory, and Society*, **9**(2), pp.110-128.

GEE, J.P., (2003). *What Video Games have to teach us about learning and literacy*. New York: Palgrave Macmillan.

GEE, J.P., (2005). Learning by design: Good video games as learning machines. *E-learning and Digital Media*, **2**(1), pp.5-16.

HAINES, T., CONNOLLY, T.M., BOYLE, E.A., WILSON, A. and RAZAK, A., (2016). A systematic literature review of games-based learning empirical evidence in primary education. *Computers & Education*, **102**, pp.202-223.

HARRIS, R. and HAYDN, T., (2006). Pupils' enjoyment of History: what lessons can teachers learn from their pupils?. *The Curriculum Journal*, **17**(4), pp.315-333.

HAVEKES, H., ARNO-COPPEN, P. and LUTTENBERG, J., (2012). Knowing and doing History: A conceptual framework and pedagogy for teaching historical contextualisation. *History Education Research Journal*, **11**(1), pp.72-93.

HUCK, J.T., DAY, E.A., LIN, L., JORGENSEN, A.G., WESTLIN, J. and HARDY, J.H., (2020). The role of epistemic curiosity in game-based learning: Distinguishing skill acquisition from adaptation. *Simulation & Gaming*, **51**(2), pp.141-166.

IJAZ, K., BOGDANOVYCH, A. and TRESCAK, T., (2017). Virtual worlds vs books and videos in History education. *Interactive Learning Environments*, **25**(7), pp.904-929.

- LAMNINA, M. and CHASE, C.C., (2019). Developing a thirst for knowledge: How uncertainty in the classroom influences curiosity, affect, learning, and transfer. *Contemporary Educational Psychology*, **59**. <https://doi.org/10.1016/j.cedpsych.2019.101785>
- MCCALL, J., (2016). Teaching History with digital historical games: An introduction to the field and best practices. *Simulation & Gaming*, **47**(4), pp.517-542.
- MCKENNEY, S. and REEVES, T.C., (2013). Systematic review of design-based research progress: Is a little knowledge a dangerous thing? *Educational Researcher*, **42**(2), pp.97-100.
- OBLINGER, D. and OBLINGER, J., (2005). Is it age or IT? First steps toward understanding the net generation. *Educating the net generation*, **2**(1-2), p.20.
- PLOMP, T. and NIEVEEN, N., eds. (2007). *An introduction to educational design research*. Enschede: SLO. Available: <http://downloads.slo.nl/Documenten/educational-design-research-part-a.pdf>
- RAZAK, A.A., CONNOLLY, T. and HAINEY, T., (2012). Teachers' views on the approach of digital games-based learning within the curriculum for excellence. *International Journal of Game-Based Learning*, **2**(1), pp.33-51.
- RIBBENS, W. and POELS, Y., (2009). Researching player experiences through the use of different qualitative methods. *Innovation in Games, Play, Practice and Theory*. Available: <http://www.digra.org/wp-content/uploads/digital-library/09287.32326.pdf>
- SCOTTISH EXECUTIVE., (2004). *Curriculum for Excellence*. Edinburgh: SEED
- SEIXAS, P., MORTON, T., COLYER, J. and FORNAZZARI, S. (2013). *The big six: historical thinking concepts*. Toronto: Nelson Education
- SHARP, L.A., (2012). Stealth learning: Unexpected learning opportunities through games. *Journal of Instructional Research*, **1**, pp.42-48.
- SMITH, J., (2016). What remains of History? Historical epistemology and historical understanding in Scotland's Curriculum for Excellence. *The Curriculum Journal*, **27**(4), pp.500-517.
- SQUIRE, K.D., (2005). Resuscitating research in educational technology: Using game-based learning research as a lens for looking at design-based research. *Educational Technology*, pp.8-14. Available: https://www.jstor.org/stable/44429183?seq=1#metadata_info_tab_contents
- TAMBORINI, R. and SKALSKI, P., (2006). The role of presence in the experience of electronic games. In *Playing video games: Motives, responses, and consequences*, pp.225-240. Available: https://www.researchgate.net/profile/Ron_Tamborini/publication/303221370_The_role_of_presence_i

[n the experience of electronic games/links/57507c7708aed9fa2bd39755/The-role-of-presence-in-the-experience-of-electronic-games.pdf](http://www.abdn.ac.uk/eitn/links/57507c7708aed9fa2bd39755/The-role-of-presence-in-the-experience-of-electronic-games.pdf)

TERÄS, M., SUORANTTA, J., TERÄS, H. and CURCHER, M., (2020). Post-Covid-19 education and education technology 'solutionism': A seller's market. *Post digital Science and Education*, 2(3), pp.863-878.

THOMAS, G. (2013). *How to Do Your Research Project. A Guide for students in Education and Social Sciences*. London: Sage

VAN ECK, R., (2006). Digital game-based learning: it's not just the digital natives who are restless. *Educause*, 41(2), pp.1-16.

VYGOTSKY, L.S., (1967). Play and its role in the mental development of the child. *Soviet psychology*, 5(3), pp.6-18.

WHITTON, N., (2010). *Learning with Digital Games, A Practical Guide to Engaging Students in higher Education*. Abingdon: Routledge

WHITTON, N., (2014). *Digital games and learning: Research and theory*. Abingdon: Routledge.