Games-based Techniques and Collaborative Learning Between Arts Students in Higher Education

By

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A Thesis submitted in partial fulfilment of the requirements for the degree

of Doctor of Philosophy (PhD) at the University of the Arts London

In collaboration with Falmouth University

March 2020

‘Games-based techniques and collaborative learning between arts students in higher education’

This thesis investigates how implementing game-based techniques delivered through digital resources can impact collaborative learning between arts students in higher education. Research into games-based learning has paid little attention to its use in the Creative Arts: STEM subjects or vocational training are often the main areas in which games-based techniques and serious games are implemented. There is compelling evidence collected from the fields of collaborative learning theories, educational technology and games research to suggest that games-based learning could be used to enhance collaboration between arts students. The phrase games-based learning within this thesis refers to the creation of an activity that utilises game mechanics to engage students, encompassing learning content and an activity that has a learning outcome.

This study examines the characterization of game mechanics, identifying which mechanics could benefit specific skills required to meet learning outcomes for enhancing and facilitating collaboration in the arts. Leadership, decision-making, communication, and creating a feeling of positive interdependence are traditional skills commonly regarded as needed for successful collaboration. This paper rests on the foundational notion that in the Creative Arts, skills such as improvisation, visualization and conceptualization are core.

This thesis presents a conceptual framework for the application of game mechanics to digital resources in the Creative Arts. This framework has been developed within a Design-Based Research methodology to provide coherence for further empirical inquiry and has informed the creation of an experimental prototype resource.

Rather than whether achievement of learning outcomes has been met, many games-based learning initiatives take student and staff satisfaction with a resource as measure of success. This thesis acknowledges the difficulties in

measuring impact on learning outcomes and to help navigate this terrain it provides methods and tools that may be used to address relevant concerns.

The contribution to knowledge from this research is a conceptual framework - a 'roadmap' for those looking to apply game mechanics in Arts-based subject areas; empirical evidence supporting the specific impact of games mechanics on learning outcomes and the use of Personal Meaning Maps as a research tool which support the analysis of collaborative working.

Key Words: games-based learning, game mechanics, collaboration, learning outcomes, Personal Meaning Maps, Design-Based Research

Acknowledgements

I would like to thank my supervisory team for their advice, patience and support over the years I have been undertaking this research. Phil Stenton for encouraging me to propose this study in the first place and whose advice helped me secure the funding without which this doctoral study would not have been possible. Tanya Krzywinska and Niamh Downing for your enthusiasm in my subject area, challenging my thinking, preventing me from taking too many diversions in my research and your invaluable feedback. Thanks also to Jemma Julian for her patience, advice and vast knowledge on how to best navigate the administrative processes involved.

Outside of my supervisory team the support of the Educational Technology teams at both Falmouth University and University of Exeter has been appreciated. Allowing me to steer the conversation towards game-based and playful learning at every opportunity and talking through the challenges I've encountered during the research. Particular thanks to Mark Williams and Nathan Steger who helped get the beacons working as I required, my JavaScript was patchy to say the least! To every participant who played a part in this research, whether agreeing to be interviewed or play-testing the prototype; thank you, without you this thesis would exist only as an idea.

Finally I must thank all of my family and friends for being there with supportive words and distractions when needed. My husband, Tom Coveney, for ensuring I remembered to eat, drink and take some time for myself whilst in the midst of writing, keeping me sane. And most importantly for ensuring that our girls were having a fantastic time whilst I spent weekends at work writing in the final push! And last, but by no means least, thank you to my daughters who have been patient and understanding, allowing mummy to write, bringing me presents and hugs to cheer me up and reminding me all along how essential games and play are to learning.

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List of abbreviations

CSCL. Computer supported collaborative learning.

DBR. Design Based Research.

DfE. Department for Education.

FPS. First person shooter.

GBL. Games based learning.

HE. Higher education.

HEA. Higher Education Authority.

MMORPG. Massively multiplayer online role playing game.

MOOC. Massive online open course.

PMM. Personal Meaning Map.

STEM. Science, Technology, Engineering and Mechanics.

VLE. Virtual learning environment.

1 Introduction

If asked to imagine what a successful artist looks like, many would paint an image of an individual working on their own in a studio suited to their practice and driven by bursts of inspiration. This popular stereotype is however, far from the reality of how most creative practitioners operate today. There will be those 'eureka' moments where inspiration strikes, yet more often a piece of work is the result of a long-term developmental process marked by false starts and multiple iterations. When we start to look at creative and artistic roles outside of the stereotype of the lone artist, we see that creativity is not an isolated experience; more often it is a collaborative process conducted across multiple disciplines. This is increasingly the case when we consider employment contexts for graduates emerging from Creative Arts courses in higher education.

After 16 years of working in institutions that provide higher education Creative Arts subjects and having graduated from a college of Art & Design, this researcher was struck by the lack of collaboration between disciplines within those institutions. Skills for employability were frequently promoted but conspicuous by its absence was the lack of focus on enhancing those skills that are required for interdisciplinary collaborative working. Where it is more common to work in 'silos', the opportunities for collaborative learning are few when undertaking an undergraduate degree in higher education.

There are of course some outstanding exceptions, for example the entire undergraduate games development course at Falmouth University is entirely focused on a team-based approach: the whole degree being an exercise in collaborative learning, specifically to emulate, as far as possible, the environment into which these students will be entering when joining industry.

There are various reasons for this lack of collaborative experience, and other studies have investigated this (Jacob 2015), however one issue that reoccurs in the literature is that collaborative learning can create, for students unused to

working this way, unease and conflict (Bentley and Warwick 2013; Gibbs 2009), perhaps due to the individualistic agenda we see throughout the entire educational experience. Students partake in individual assessment and work as the 'norm' during school and further education. To then come to university and be expected to understand the importance of and skills required for collaborative working is unrealistic. There is a marked, underlying tension in collaborative learning and teamwork; the learner is concerned with both their individual journey and goal to complete the course and obtain individualised certification, whilst simultaneously navigating the complex social and psychological dynamics inherent to working as part of a team. Whilst the collaborative experience is more reflective of life outside of the closed confines of an undergraduate degree, there is a lack of tools available to address the problems that regularly arise. If support can be put in place that allows for a totally group focused approach, enabling the group work to be viewed as a whole yet which allows participants to feel ownership over their individual contribution, then the anxieties around collaborative working would be alleviated and the experiences that help to build resilience and strategies for working in groups gained.

It is not realistic or appropriate for every degree to follow the Falmouth BA Games Development model, however every Creative Arts degree should include opportunity for interdisciplinary collaborative learning. For this to happen there needs to be a greater variety of tools and activities available to support this valuable learning context.

This study considers using games and games-based technique to enable collaborative learning. Outside of working in Higher Education e-Learning, this researcher has a special interest in games, both digital and non-digital, 'serious' and 'casual', collaborative and competitive. As this study describes, frequently games require participants to collaborate in order to achieve a shared goal. Whether as part of a group of a friends, or with strangers online, this researcher noted the ability that games have to support collaborative working and learning.

As a result of the observation that there is a gap in the provision of collaborative opportunities in Creative Arts higher education, alongside a recognition of the potential of games to support groups of people working together, this research was conceived.

As this thesis will go on to discuss in greater detail, the growth of using games and play for learning in higher education is evident; although there is a background of games used within creative education, studies on the impact of games-based learning had paid 'little attention to the field of Arts and Design education' (Peppler & Kafai, 2007); a situation that has not improved in the years to date evidenced by a lack of current research in this area.

1.1 Paradigm shifting

This study has taken place over a seven-year period. This researcher has been undertaking the research on a part-time basis whilst working full-time as an Academic Advisor for Educational Technology, with two separate years of intermittence to allow for maternity leave. The challenges of balancing these competing roles have at once been both inspiring and frustrating, but all have influenced the direction of this study.

Over the period of time that this researcher has been working within the field of Educational Technology, there have been huge shifts in how digital platforms and tools are used to support teaching and learning. Reflecting the current changes and trends in pedagogy, the use of digital has become increasingly focused on enabling an active learning approach, moving away from a 'sage on the stage' approach to a more 'guide by the side' philosophy. The ability to personalise learning experiences through technological solutions is increasing, with many looking to enable students to work at their own pace, cater for accessibility requirements, improve engagement and contribute to better retention. In addition, technological changes resulting in more students having

access to smart mobile devices has led to increased opportunities for collaborative authorship, team-based working, forming communities of practice and the development of online portfolios. Identification of engaging, evidence-based solutions is regarded widely as key to supporting this digital transformation whilst maintaining high standards for learning experiences.

As a result, we are increasingly seeing innovative approaches including curricula co-design, blended learning approaches, gamification, digital badges and massive online open courses (MOOCs) becoming of interest to higher education institutions as a way of engaging and motivating the student population.

To capitalise on the interest from institutions around gamification, most virtual learning environments (VLE) now offer a way to integrate 'Open Badges' into their online courses. These digital badges contain verifiable metadata that relate to specific achievements within the VLE, providing a visual representation of accomplishments. The Open Badges standard is described as 'a method for packaging information about accomplishments, embedding it into portable image files as a digital badge' (Open Badges 2016). When this research study first began Open Badges were a pilot initiative between Mozilla and the City of Chicago for a project that ran over a summer to motivate young people to stay active. Seven years on, the use of Open Badges is recognised globally as an online standard that enables the implementation of portable digital badges across multiple platforms. The effectiveness of these badges in aiding learning is much debated as the contextual review in Chapter Two will consider, however regardless of whether their use is seen as a token offering to the incorporation of game pedagogy into VLEs, they have succeeded in initiating a meaningful discussion that encompasses a range of relevant areas including games-based learning, digital innovation, pedagogy and game philosophy.

Badges are just one example of how the acceptance of games and games-based techniques in education is becoming more commonplace. Whereas seven years ago the conferences, journals and special interest groups regarding games and learning seemed like a niche interest area, we now see MOOCs for those

interested in Serious Games to enrol onto, Citizen Science games are commonplace in exhibitions and educational software is regularly gamified. The concept of games and learning is no longer the domain of the specialists as it has moved into the wider academic consciousness.

As well as being employed within the general field of education technology, over the last seven years this researcher has been an active participant in the specific field of games-based learning. This has included presenting at relevant academic conferences (including the Irish Conference on Games-Based Learning) which then led to the contribution of a book chapter entitled Games-based learning in the Creative Arts, in *Game-Based Learning and the Power of Play: exploring evidence, challenges and future directions* (Rooney and Whitton 2016). Participation in special interest groups and acting in an advisory position to research groups. Consequently, this researcher has been invited to conduct occasional peer reviews for two academic journals, '*Games and Culture'* and '*ALT Research Journal'*, as well as peer review papers submitted to the 'Playful Learning' conference. These activities have provided an excellent platform from which to observe the evolution of games-based learning research over the last seven years.

With regards to specifically games-based learning in the Creative Arts, this researcher has observed that there has remained a significant lack of studies considering how games and play can support the skills required for Creative Arts practice. Taking the workshops and presentation at the Playful Learning conference over years 2016, 2017 and 2018 as an example demonstrates this gap in the research. The conference itself is playful in its approach, encouraging all sessions to ensure there is a playful element, rejecting the traditional purely PowerPoint-led style. A place for disseminating findings from current evidence-based research and teaching practice, it also aims to create a conducive environment for inspiration and networking. The range of subjects that presenters have applied games-based and playful learning to is vast and includes: Assessment, Biology, Coding, Dementia care, Digital literacy,

Fieldwork, General academic skills development, Healthcare, Library engagement, Maths, Professional development, Research design skills, Sustainability and University Inductions. Submissions are welcomed from anyone discussing the use of play or games in adult learning.

From approximately one hundred workshops and activities, only *three* have focused specifically on a creative arts subject and these were all concerned with creative writing and narrative. In 2016 a workshop from David Jackson (Jackson 2016) considered how 'Can games help creative writing students to collaborate on story-writing tasks?' Jackson presented a case study which demonstrated how creative writing students responded when play testing group writing games. In 2017 Carla Hamer and Linda Matti (Hamer and Matti 2017) presented a session considering the playful exploration of grammatical structures through art. Also in 2017, Benjamin Hall and Jo Hassall (Hall and Hassall, 2017) explored creating collaborative shared narratives with game-like interventions. Although there were only three sessions that focused on implementing games-based learning / playful learning specifically in Creative Arts subjects, the benefits to creativity of playful and games-based learning have been acknowledged by more than one of the keynote speakers at the conference over the years, further supporting the need for this studies investigation into how games-based learning may aid aspects of creative arts HE study.

Nikki Woods spoke at the conference in 2017, sharing her experiences as a performer and teacher, encouraging us to create new fictional worlds by rethinking familiar places, creating new narratives and characters in the process. Deborah Bullivant also delivered a keynote presentation in 2017 considering how an artistic, playful approach may impact on children's literacy. Alison James, who keynoted at the 2019 conference, has worked in multiple Creative Arts institutions; her work often focuses on using play to foster creativity and critical thinking, developing creative pedagogies. Time and again we see the positive links between play, games, creativity and learning. Many an arts project or performance will include elements of playfulness (including

audience participation) however rarely does games-based learning seem to be taken up by educators in the Creative Arts subject areas to aid in the delivery of curriculum. It is the task of this thesis to remedy this.

1.2 Aims and Objectives of this study

This thesis will consider how the implementation of game-based techniques delivered through digital resources can impact collaborative learning among Creative Arts students in higher education (HE).

The research **aims to:**

- Contribute to educational theory regarding game mechanics in digitally-enabled learning experiences by identifying how game mechanics can enhance collaborative learning among arts students in HE.
- Identify how individual game mechanics impact on specific learning outcomes.

The research will achieve these aims through meeting the following **objectives:**

- Identifying examples of digital resources incorporating games-based Learning (GBL) used in HE.
- The investigation of the pedagogy of collaborative learning theory and its influence on the design of digital resources.
- The creation of a conceptual framework for the application of game mechanics to digital resources in the creative arts.
- The characterisation of game mechanics; identifying specific mechanics that will support individual learning outcomes.
- The creation of a series of experiments to measure the impact of game mechanics on learning outcomes.

1.3 Relevance and importance

Creative Arts graduates will continue to enter into industry environments that require interdisciplinary collaboration. There is a demand for evidence-based methods to enable the development of the skills required by employers as institutions seek ways to equip their graduates for a competitive, collaborative environment.

This thesis builds on existing research and offers ways forward for those in a Creative Arts context to implement games-based learning. The uptake of games-based learning is continuing to grow in many subject areas, this thesis will contribute to the knowledge base that Creative Arts educators can draw upon in order to implement games-based activities in pedagogically sound ways. Whilst there has been previous research considering games-based learning to enable collaborative learning, none has focused specifically on a Creative Arts framework or specifically considered collaboration to enable an interdisciplinary approach. As the aims and objectives demonstrate, this thesis provides a pathway from inception to evaluation, signposting to, implementing and critiquing relevant methodologies, discussing and demonstrating how to integrate game mechanics into learning activities, all within the context of a Creative Arts subject area. In addition, it is expected that this research will be used as a launchpad for further investigations into the benefits, challenges and practicalities of engaging with games-based learning in Creative Arts higher education.

Alongside the theoretical contributions, this thesis will demonstrate the practical application of current technologies available to enable locative games-based activities, specifically multi-functional, programmable, Bluetooth beacons. It is important to build upon the experimentation and use of these technologies in open source forums and implement them into educational practices, in order to evaluate their value and appropriateness. It should be noted this study is not prescriptive in the technologies that should be used

within a games-based approach and proposes a framework to design the activities rather than dictate the tools used.

1.4 Thesis outline

This introduction forms Chapter One of the thesis and outlines how the research questions and topic area was conceived. It introduces the aims and objectives that this research study has been built upon and identifies the contribution to knowledge that this thesis will offer. The introduction has also acknowledged that this research has taken place over a period of seven years and presents some observations regarding the fields of educational technology and games-based learning in higher education during this period.

Chapter Two presents a contextual review that introduces the learning theories which form the pedagogical foundations of this research. It will examine the idea of games and play, defining what a game is, how this definition has been contested and why this definition is essential in creating the foundations for this body of work. It also outlines the definition that this research will subscribe to in terms of game mechanics, justifies this in the context of the research and begins to discuss the importance of considering the selection of game mechanics in line with the learning outcomes required from an activity. Overall this chapter sets the scene in terms of where we are with games-based learning in higher education Creative Arts and justifies why we should explore the use of games-based techniques to support collaborative learning.

Chapter Three outlines the research design used in this study. It discusses the methodology underpinning the research, looking at why in principle these methods, tools and techniques have been selected. It considers in detail what they are, where they have been used previously, their general value, as well as why they are of specific interest to this research. This chapter also outlines the ethical considerations and safeguards that have been put in place.

Chapter Four introduces the Conceptual Framework that was designed as a result of this research. The framework was designed to inform both my own empirical research, and to provide a toolkit for others. It ensures that the impact on learning outcomes is the primary driver in design as well as providing a useful model for discussion. It explores the component parts that need to be considered and at which stages the methods outlined in the previous chapter will be used. Each stage of the framework is presented with specific consideration given to a Creative Arts context. It addresses key issues such as pedagogical approach and the desired learning outcomes that are relevant to any subject area. It also considers how students may extract work that they have created as part of the process for their portfolios, or to continue to work in a collaboration that extends beyond this particular activity.

Chapter Five discusses the design of the experimental prototype used in this research. It includes reflecting on interviews with professionals from both teaching and learning technology and how the resulting data effected the design of the prototype. We see the application of some of the methodologies and tools outlined in previous chapters, translating theory into practice. This chapter concludes with the design for v.1 of the prototype activity.

This thesis goes on in Chapter Six to present the implementation of the games-based activity and considers the practicalities of running this prototype. This chapter discusses the challenges and opportunities discovered in the process of conducting the activity, including the recruitment of participants, how the nature of locative open-air environments impact testing and importantly how the iterative process was implemented. I will show that intervention and development is a key part of a Design-Based Research process. This chapter outlines the interventions taken, why they were felt to be necessary, how they were undertaken and the resulting change to the activity.

Chapter Seven looks at evaluating effectiveness for learning. It implements the solutions identified earlier in the thesis for measuring impact on learning and shares the data and feedback that has been collected. The effectiveness of

using a Design-Based Research methodology is considered including the impact it had on final design of the activity. The methods used to collect and evaluate data are discussed, including the challenges and advantages that these methods presented. A selection of Personal Meaning Maps are presented here, along with information regarding the process used to analyse them. As demonstrated, educational effectiveness is considered by evaluating the impact of the activity on learning outcomes.

Chapter Eight concludes the thesis with an overview of aims and objectives and evaluate the extent to which the research has addressed them. It will consider the contribution to knowledge by this study and how the findings of this study fit into the wider picture contemporary higher education. The chapter will discuss recommendations for further research that includes building upon the prototype presented in this thesis, considering how the conceptual framework may be presented as an ongoing resource and further topics to explore that have arisen as a result of this work.

This thesis builds upon pedagogies rooted in the fields of educational technology, collaborative learning and games-based learning. It considers the growth of the use of games for learning and pays particular attention to the potential for games-based activities to enhance collaborative learning in the Creative Arts HE sector. It sets out the theoretical and practical considerations around the inclusion of games-based activities into a Creative Arts curriculum, providing a framework and detailed guidance for educators wanting to implement a games-based learning approach.

2 Contextual Review

This chapter examines literature from the fields of games theory, collaborative learning theories and educational technology (specifically games-based learning). With regards to collaborative learning and educational technology, particular attention is given to work that has considered a higher education (HE) setting. In order to highlight the need for such an investigation this section will consider the background of non-digital games being used in Creative Education and explore the use of games-based learning to support collaborative learning. This review demonstrates that despite the suggestion that games are inherently beneficial to creativity alongside the acknowledgement that collaborative working and learning are essential skills for those studying Art & Design subjects, there is a significant gap in knowledge. This gap is present in both the fields of Games as well as Educational research. This chapter concludes with an outline of how this study intends to address this lack of knowledge and to focus attention on the implementation of games-based learning in Creative Arts subjects.

Games have long been a form of entertainment, as sources of learning and socializing. They help to create and support community, therefore forming an integral part of a society. Evidence of gaming has been found throughout human history with some of the earliest known examples being identified through archaeological digs in Ancient Egypt. Scenes depicted on tomb walls show the deceased playing *Senet*, an ancient board game, and examples of the game board itself have been found in proximity to both royal and lower class habitations alike (British Museum 2014). Games have been hailed as useful exercises for developing strategic thinking, preparing soldiers for war (Smith 2009). They also provide insights into the depiction of war in popular culture. *Vacuation* (1939), for example, is a game concerning British child evacuees, or *Royal Aerial War Game* (1914), which focused on the strategic bombing of

enemy cities - a game that could be bought in the local Boots Chemist (Lewin 2012).

Many are not aware that the game widely known as *Snakes and Ladders,* a game commonly played in childhood, originated in India and was called *Mokshpat*. It was created in an attempt to teach morality and the effect of good and bad deeds. Brought to Victorian England the game was re-named to what we know now, however the idea that the ladders represented virtues like kindness, generosity, and faith and that the snake represented vices including lust, anger and greed was largely forgotten. Instead the movement up ladders became associated 'with grace and success while snakes represented disgrace and poverty' (Groenewald 2019).

Yes, games are played for entertainment however time and again attempts are made at communicating or teaching a lesson alongside the play value of the game. A well-known family game, *Monopoly* started life as a *'The Landlord's Game'* in 1903, designed by Lizzie Magie intended to demonstrate the issues surrounding the monopoly of property ownership. Games are universally accepted as useful ways for children (and at times adults) to learn social, coordination and communication skills and here the line between play and games becomes blurred, a core issue this chapter will return to.

In more recent years many of these well-known games have been reformatted to enable play on mobile devices and computers. As video games have moved into mainstream culture so the acceptance of them, as a form of entertainment at least, has increased. In the UK the games industry now accounts for 'more than half of the UK's entire entertainment market' (BBC 2019), generating more income than music and film combined.

2.1 Gamification

This interweaving of games with so many areas of our culture and society has inevitably been seized upon by commercial interests and it should come as no surprise that businesses have been considering ways to capitalize on the power that games have to engage and motivate. The application of game-based techniques to non-game environments and situations has been driven by the increased knowledge that game mechanics influence behaviour (Fullerton, Hoffman and Swain 2004; Järvinen 2008; Sicart 2008), often as a form of positive or negative reinforcement along behaviourist lines. Using incremental rewards, feedback loops and progress bars, we are seeing a growth in the use of gamification to incentivise use of a service or product, encouraging people to act in ways they would not have done otherwise. The term 'gamification' was coined by Nick Pelling in 2002 and was intended to mean, 'applying game-like accelerated user interface design to make electronic transactions both enjoyable and fast' (Pelling 2011). It is now commonly used to denote the use of game elements within a non-game environment and has become integrated in many products and websites in order to engage and motivate consumers, to collect data and aid marketing.

The networking site, *LinkedIn* utilises the mechanic of the progress bar and levels for example. By providing users with a visualisation of their 'progress' *LinkedIn* successfully responds to the desire for the achievement and completion of goals, common to many people. As a result the company has been able to gather more user data than people would otherwise have submitted to the site. Another popular technique is the use of badges. Badges can be used to signify progress and achievement: outside of digital games the use of badges can be seen in the Scouts or in various sporting activities. While some are questioning the use of extrinsic incentives such as badges (Hecker 2010), others claim using badges can result in 'a social shaping of user activities' (Antlin and Churchill 2011: 2): *Foursquare* (a location-based social networking

app) is an example of this. Users of *Foursquare* are encouraged to 'check-in' to places, gaining badges for certain actions, such as the 'Explorer' badge for having 'checked-in' to twenty-five different locations, or the 'Jetsetter' badge for 'checking-in' to five different airports. (Foursquare 2014).

Microsoft Office labs introduced *Ribbon Hero* (Stahl 2010) to encourage people to explore the functionality that the various MS Office packages have to offer. It uses a score mechanic to encourage people to utilise new tools and provides challenges, missions and achievements to change the way people use MS Office. In the world of personal fitness, *Nike+ fuelband* (Nike 2014) is worn and works like an accelerometer, recording data such as movement and calories burned. Additional software has been introduced that enables the user to set goals, compete against others using leader boards, and to share results across social media networks.

After an initial boom in the popularity of gamification there has been, as with many popular trends, a backlash: growing numbers of people feel the concept needs to be re-thought. Criticisms are evident in the repositioning of the term gamification as interchangeable with the term '*exploitationware'* (Bogost 2015: 72). Some argue that gamification is being used as a smokescreen to make a 'bad' thing 'good'. All such criticism have prompted concerns regarding the relationship of gamification to game design. A collection of essays on the 're-thinking of gamification' (Fuchs et al. 2014) provides an innovative and broad approach to the use of the phrase 'gamification', reframing and reclaiming a word that for many has been misused and misrepresented. This demonstrates a body of literature within game studies that has appraised the value of gamification in economic, social and psychological terms.

Another recent development in the spread of the use of gamification outside games is its ability to aid decision-making. Søren Peterson and Ryu Blake (2015) have demonstrated using gamification to identify innovative design concepts. As well as providing an indication of how successful a design concept may be, they found this method 'promotes extended risk-taking, [and]can assess team-confidence and decision-making ability' (Peterson and Blake 2015: 96).

From location-based social networking to fitness apps and desktop applications, there are many examples of using games-based techniques or 'gamification' to encourage changes in behaviour. Whilst this may be an appropriate use for business or leisure purposes, the term 'gamification' does not address issues crucial to learning, these include address of evaluation and achievement, retention and success. The challenge in an educational setting is not only to increase engagement and motivation as the gamification examples above suggest, but also to demonstrate that specific, pre-defined learning outcomes have been achieved.

Something having been gamified does not mean it necessarily challenges a learner for creative solutions or engages them deeply in the process of learning. Gamification is usually implemented in a very regimented way. It is often a progress monitor rather than something that challenges thinking. It provides a superficial layer that may well attract more attention yet often it is not equipped with the means of encouraging the intrinsic motivation an individual might have to improve and learn (or play a game). If extrinsic rewards such as badges or level-ups are to be of benefit they need to provide some positive feedback on a participant's competence otherwise there is a danger of failing to encourage the desired behaviour (learning), resulting in a potential drop off in intrinsic motivation. The psychological concept known as 'over-justification' illuminates this and work by Edward Deci and Richard Ryan (1985) concerning Cognitive Evaluation Theory carefully outlines how a participant's perception of

autonomy and control are directly affected by the way extrinsic factors (such as reward) impact on intrinsic motivation. Impact occurs due to the pleasure experienced from satisfying the human psychological need for competence, in this case acknowledged by a reward, increasing intrinsic motivation. Research within cognitive neuroscience (Howard-Jones et al. 2011) suggests this benefit is a result of a physiological response, the release and uptake of dopamine. To be of maximum benefit extrinsic rewards need to consist of useful information delivered in a non-autonomous way for maximum beneficial effect. Any educational activity that utilises games-based techniques needs therefore to balance very carefully the game mechanics implemented with the desired learning outcomes, and importantly, consider how feedback is provided.

The use of the term 'gamification' can be misleading in an educational context. It does not in itself imply an activity that will enhance learning, or require that outcomes are carefully considered. Design of challenge or feedback are an essential consideration in learning experiences and simply 'gamifying' something does not address these areas either. The research that underpins this thesis is designed to present a new and innovative approach to harnessing the beneficial aspects of games to encourage collaborative learning as well as developing an alternative terminology that is both appropriate to a wider remit and which is unambiguous thereby helping to establish a ground from which others are able to take up this work.

2.2 Games

This section begins with an examination of the idea of games, working towards a definition of what a game is, showing how definitions have been contested and why it is important to define games to provide a foundation for the rest of the research.

2.2.1 What is a game?

In order to identify what constitutes a games-based technique, this research needs to consider the seemingly innocuous question – what is a game? This question has been asked and then addressed by philosophers, academics and game designers alike and such a question leads us to consider the very nature of play. While we 'play' a game, and the participants are known as 'players', not all instances of play can necessarily be called a game. To understand this important distinction further we need to examine play theory, the aim of which is to understand the nature of play. This then provides a starting point from which to consider game theory.

Dutch historian Johan Huizinga's theoretical work on play, most notably published as *Homo Ludens: A study of the play element in culture* (Huizinga 1949), locates play as an intrinsic part of human behaviour and as such it is deemed to have a significant influence on culture and society. Rather than focusing on a biological or physiological purpose for the nature of play, Huizinga posits play as superfluous, something that can only be undertaken freely, simply for the enjoyment of the experience itself. Partaking in play thereby involves 'stepping out of 'real' life into a temporary sphere of activity' (1949: 103). French Sociologist Roger Caillios, (joint founder of the Paris College of Sociology in the 1930s) observed differences between the natural world and human society, interpreting many instances of behaviour as forms of play. Caillios (1958) builds upon the notion of Huizinga's 'magic circle' and similarly describing play as 'essentially a separate occupation, carefully separated from the rest of life'. However, Huizinga asserts that playful activity is at the root of religion, art, music, performance; even if the experience of play itself takes part in a separate space, its influence is certainly felt within the everyday.

Brian Sutton-Smith's book *Ambiguity of Play* (1997) provides a practical and thought provoking viewpoint that considers various play theories. He bases play within seven culturally defined ideological rhetoric's. Through this classificatory method play is acknowledged as existing both within its own sphere and as an intrinsic part of 'real life'. For example, the rhetoric of 'play as progress' accounts for the notion that children (and animals) learn and develop through play. Sutton-Smith does however seek to acknowledge the *ambiguity* of play, ambiguity caused by the diversity of situations that we refer to as play, the diversity of the players themselves, and the range of tools and props that can be used for play. Using these categories it is possible to describe what type of play is being observed, the forms it might take, a theoretical framework that may be associated with it and the effect that this type of play may have on the participants or players.

Play evidently is a different activity to different people, and undertaken with different motivations. Play can be engaged within a social context, but also individually, usually providing a space where experimentation and failure are acceptable and sometimes even welcome states. Whilst play may be undertaken without purpose, the outcome of play may be unintentionally beneficial. 'The notion that play is, by its very nature, frivolous and purposeless does not take account of the wide variety of types of play and the variety of effects (and outcomes) that playfulness can lead to' (Whitton & Moseley 2019:178).

Whilst these studies of play have provided insight into the different forms that play may take and the human motivation for playing games, they do not provide a definition of a game or how that differs from play. Katie Salen and Eric Zimmerman (2004) conducted a comparison of various game definitions and found that among eight definitions there was no clear agreement on what constituted a game. The only element that featured across all but one of the

definitions was that a game should include rules. For many critics this is what distinguishes games from the notion of play: 'probably the most basic definition of a game is that it is organized play, that is to say rule-based' (Prensky 2007: 119). Rules provide the defined boundaries and limitations within which players operate; they define the terms that govern ways in which players interact with each other and the game. As Huizinga suggests, the 'rules of a game are absolutely binding and allow no doubt' (1949: 11).

The ontology of games has provoked heated debate and what seems ostensibly to be a fairly simple question becomes very difficult to answer; to some extent trying to define 'game' becomes a largely subjective activity of exclusion. Jesse Schell boldly states that 'we all know what a game is', (2008: 24) stressing that the importance of seeking a definition lies not in discovering what a game *is* but in the practice of discussion and investigation, which requires analytical thought and careful consideration.

In *Philosophical Investigations*, published posthumously in 1953, Ludwig Wittgenstein declared there was no common trait that could cover all those activities we label as games, only a 'complicated network of similarities overlapping and criss-crossing' (1953: 32) and therefore there could be no final definition of the word 'game'. Wittgenstein used the word 'game' to demonstrate his concept of 'family resemblance', which allowed for differences in type and kind, and declared that the activities we call games were actually a family of related activities with nothing that is common to them all. Bernard Suits book, '*The Grasshopper*,' published in 1978, provided a direct response to this statement, (although Suits did not intend this work to be an 'anti-anti-definitional manifesto'). Re-telling the fable of the Grasshopper and the Ants, Suits conducts a complex discussion around the nature of games and game playing. Whereas Wittgenstein instructed the reader to 'look and see', promising that if one followed his advice they would see no commonality, Suits

declared that 'Wittgenstein himself 'looked, to be sure, but because he had decided beforehand that games are indefinable, his look was fleeting, and he saw very little' (2005: 21). Suits looked beneath the veneer of games and identified four elements that are common to all games: the goal; the means of achieving the goal; the rules; and the lusory approach which he distilled to the following definition – 'game playing is the voluntary attempt to overcome unnecessary obstacles' (2005: 55).

Suits idea of a 'lusory approach' directly refers to the attitude of the game player. Often players partake in games where the rules prohibit the most efficient means of overcoming obstacles, in favour of less efficient means. For example, on a simple game track the aim may be to get your counter from point A to point B. The most efficient means of doing this would obviously be to pick up the counter and move it from Point A to Point B. However, under the rules of the game this efficient method is not allowed. Instead the counter needs to stay on the track navigating various obstacles and succumbing to the random nature of the dice. If this level of inefficiency occurred in a day-to-day activity, such as walking from one building to another, the rules and regulations would be considered bureaucratic and needlessly complicated. As Suits explains, it is having a lusory approach that enables the 'acceptance of constitutive rules just so the activity made possible by such acceptance can occur' (2005: 54).

With so many definitions of 'game' having cultural currency, Nicola Whitton found it 'unhelpful and artificial – if not impossible – to create an absolute division of what is (and is not) a game' (2010: 22). Instead, in the interest of creating an 'open definition of game', she examines classifying activities in terms of how *game-like* they are, based on how many game characteristics they embody. Whitton refers to ten characteristics that frequently appear across the literature: Competition, Challenge, Exploration, Fantasy, Goals, Interaction, Outcomes, People, Rules and Safety. These characteristics are expanded on in Table 2-1.

Characteristic	Definition
Competition	The goal is to achieve an outcome which is superior to others.
Challenge	Tasks require effort and are non-trivial.
Exploration	There is a context sensitive environment that can be investigated.
Fantasy	Existence of a make-believe environment, character or narrative.
Goals	There are explicit aims and objectives.
Interaction	An action will change the state of play and generate feedback.
Outcomes	There are measurable results from game play (e.g. scoring).
People	Other individuals take part
Rules	The activity is bounded by artificial constraints.
Safety	The activity has no consequences in the real world.

Table 2-1: Whitton 2010: 23

Whitton's table omits two important characteristics that could be described as participant or player characteristics, firstly the idea of a 'lusory approach' as discussed above, and secondly, the element of voluntary participation which appears throughout various definitions of games (Caillois 1958; Suits 2005; Sutton-Smith 1997). These are equally essential to bear in mind when considering definitions of games; without these characteristics it is questionable whether the participant is partaking in a game and not simply in an activity. Voluntary participation presumes an element of choice in terms of whether a player partakes in a game, thereby raising questions about whether a game is indeed still a game, if a participant is forced to play. This is particularly relevant to games-based learning where games may be used as part of the curriculum and will be taken into consideration within the design of activities, specifically how student participation is facilitated.

As this research focuses on games-based techniques in a collaborative learning **context** rather than the creation of games themselves, a combination of Whitton's ten characteristics alongside the inclusion of the participant characteristics of lusory attitude and voluntary participation are used as a grounding for the development of the game-based activities created as part of this study.

2.2.2 Game mechanics

It is game mechanics that aid interaction between a participant and the game itself. They are intrinsic to a game's rule set and often allied to the overarching concept of the game, 'connecting "players" actions with the purpose of the game and its main challenges' (Sicart 2008). Within digital games the mechanics are present as computational constructs (rather than as a social agreement as is the case with board games). However, as with the term 'game', there are various definitions of exactly what constitutes a game mechanic. Salen and Zimmerman consider game mechanics as representing, 'the essential moment-to-moment activity of players' and creating 'patterns of repeated behaviour, the experiential building blocks of play.' (2004: 317) Miguel Sicart also highlights player activity when describing game mechanics as 'methods invoked by agents for interacting with the game world' (2008); using the term 'agents', he allows for the possibility of both player characters and non-player characters to effect the game state through a game mechanic.

Some definitions make no attempt to differentiate between the concepts of rules and mechanics; these definitions primarily seem to come from games designers. Sus Lundgren and Staffan Björk define game mechanics as:

> [A]ny part of the rule system of a game that covers one, and only one, possible kind of interaction that takes place during the game, be it general or specific (…) mechanics are regarded as a way to summarize game rules. (2003: 4)

Richard Rouse also combines the idea of rules and mechanics as, 'what the players are able to do in the game-world, how they do it, and how that leads to a compelling game experience' (2005: 310). Whereas Charlie Cleveland specifically states: 'game mechanics are rules, player choices, and other designs that have been created with intent and consequence in mind' (2002: 85). The relationship between mechanics and rules can become blurred as we can see from these 'definitions', yet the two are fundamentally different. Mechanics enable interaction with the game; put simply – what you are asked to do. Indeed what is asked of players can define the mechanics. Rules are in place to govern these interactions, when, where and how you can utilize the mechanics available. This ontological distinction between rules and mechanics is considered in more depth by Sicart (2008).

Within games-based learning activities, it is the mechanics that will instigate and support learning, enabling students to interact with the digital activity and take actions. Whilst it is desirable to incorporate alluring game elements such as fully-realized 3D environments or an orchestral score, it is the selection of the core mechanics that will determine the impact on learning outcomes (it should be acknowledged that game elements such as orchestral score can also be implemented as a mechanic). Therefore it seems appropriate for the purposes of this research to subscribe to Jesse Schell's definition of game mechanics as: 'the interactions and relationships that remain when all of the aesthetics, technology, and story are stripped away' (2008: 30).

Schell identifies six main categories of mechanics outlined below which will be referred to in more detail as part of the design of games-based activities in this study.

Mechanic 1: Space. Every game takes place in some kind of space – whether that is a space is generated by a game board, the environment within a computer game or the space between people. Schell recommends stripping away all aesthetics & technology and thinking of space in a functional abstract way. The game space/s lets us know where the game will happen and how those places are related.

Mechanic 2: Objects, Attributes, and States. Schell refers here to any objects within the game. Attributes provide information about that object, and each attribute has a specific state. For example, the object may be a character in a computer game: an attribute would be that character's health bar, and the state could be 50% health.

Mechanic 3: Actions. This term covers operative actions available to the player such as 'move counter', 'jump', 'shoot' and 'resultant' actions that are related to the ways in which a player combines their operative actions into a strategy in order to achieve the goal.

Mechanic 4: Rules. Schell classes 'Rules' as a mechanic, describing them as the mechanic that provides the boundaries for all the other mechanics, including where they can happen, how, when, and to what end. Given the ontological difference between rules and mechanics as outlined above, Schell's 'Mechanic 4' will not be referred to as a mechanic in this research. Rather, I work from the

premise that the rules govern how the mechanics interact rather than functioning as discrete mechanics in themselves.

Mechanic 5: Skills. Schell is unusual in that he specifies player 'skills' as a mechanic, stating that every game require players to exercise certain skills, whether these are physical skills (dexterity, coordination), mental skills (memory, puzzle solving) or social skills (teamwork, bluffing). By examining the application of player skills in this way it is possible to consider the challenge presented to the players, which skills are required, how their improvement impacts gameplay, and in the context of this study whether these skills contribute to the desired learning outcome.

Mechanic 6: Chance. This depends to a certain extent on the interactions of the previous mechanics outlined, and how much risk and randomness a designer wants to incorporate into a game. Chance is always present, even without an intended 'random' element of the game as any reliance on the skills of a player to make decisions incorporates an element of unintended possibility.

Schell's model with its composite parts, serves us well for dealing with the challenges of implementing game mechanics into learning activities and will guide the design process. The incorporation of game mechanics into a task requires the student-participant to take an action and to think more carefully about what they are doing. Thoughtful participation as opposed to a passive experience. Through careful consideration of the mechanics employed, the interactions that a player has with a game can be designed and predicted. There is no guarantee of a particular outcome, however, which makes it vitally important in the context of games-based learning, to use game mechanics in such a way that will support the desired learning outcomes and have a pedagogical purpose.

2.3 Serious Games and games-based learning

The growing acknowledgement that games can be used to educate, change behaviour and engage an audience is demonstrated by the expanding field of 'Serious Games' and the increasing interest in games-based learning. As well as an increased prevalence of such games, there is a growing body of research disseminated at conferences and in academic journals, dedicated to this subject. Consideration of these games is important for the project as they have often repurposed elements of games designed for entertainment for other purposes, as is also the intention of this research.

2.3.1 Serious Games

Serious Games are generally understood as having a primary purpose other than that of entertainment. While not a new concept in terms of using games to train and educate, it is only since the turn of the twenty-first century that the remit for serious games has expanded beyond training to cover a broad range of subject areas (Djaouti et al. 2011) including science, social activism, politics and business. Serious Games or 'Games with a Purpose' (GWAP) have attempted to harness the analytical and pattern recognising abilities of thousands of people in order to train AI algorithms or solve complex problems. *The ESP game* (later renamed *GWAP*) (Saini 2008) was one of the first examples of this, using the playing public to assist with metadata or labelling for images. Players were paired with a random person and both shown the same image. In order to progress through the game each player would need to assign the same label to that image. Once both players had done this the next image was shown, a total of 15 in two-and-half minutes. The results provided enhanced image metadata, which enabled more accurate and productive image searches. The original concept was considered to be so successful that Google bought a licence from

the creator and developed their own version of the game to aid the return of image searches.

Gameplay implemented to support scientific research can be seen with the game *Foldit* (2011, University of Washington), which focuses on protein folding and scores players on how well a protein has been folded. Players of *Foldit* have helped to decipher the structure of a virus carried in monkeys that scientists had been trying to solve for 15 years. Within ten days of the puzzle featuring on *Foldit*, players had produced an accurate 3D model of the enzyme (Khatib et al. 2011).

Serious Games, or what have become known as Citizen Science games are being included in physical exhibition spaces, featuring people who might not normally engage with online games, or usually engage with a particular subject area. A recent example of this is at the Eden Project in Cornwall, UK. They dedicated an area to Citizen Science games in their permanent exhibition *Invisible Worlds,* launched in 2018. The games that were installed in this area had been designed and run by FoAM and gathered data for scientific research on ecology and evolution. *Crab Camouflage* (originally commissioned by the Natural History Museum) and *Dazzlebug* both shared with players the data that had been collected to date, ensuring participants were aware of how their actions had been contributing to the research (Griffiths and Johansson 2019).

As with games designed for learning, each of the examples above began with a set of clearly defined outcomes (in these cases data gathering outcomes as opposed to learning outcomes) and the game mechanics used were chosen to achieve these. With all games it is a necessity to engage players in order to make the games a success. A mechanic core to games for entertainment, relevant feedback, has featured as an essential aspect of these serious games. Feedback in these games occurs during game play, with the notification of correct or incorrect answer, but most significantly feedback doesn't stop when the gameplay ends, players are presented with information concerning the data

gathered through gameplay and how this is helping the scientific research. There is a motivation provided for players to 'try again'. Not only to perhaps better their score, but also to contribute more to the scientific research. Players now have a positive value attached to their game-play, it is recognised as worthwhile.

2.3.2 Games-based learning

The term 'games-based learning' (GBL) has been used to refer to the use of games, simulations and virtual worlds for educational purposes with defined learning outcomes. Within this thesis, the term 'games-based learning' (which may be abbreviated to GBL) refers to the creation of an activity that utilises game mechanics, and which engages students through learning content and has learning outcomes.

James Paul Gee, was one of the earliest academic advocates of games as learning tools. His paper and subsequent book both entitled *Good video games and good learning* both discussed in depth the idea that 'Good video games incorporate good learning principles, principles supported by current research in Cognitive Science' (Gee 2006:3). Gee has never insisted that video games should necessarily be used within teaching but rather the 'deep ways of teaching and learning that game designers use in order to motivate problem solving' (Wan 2016) are investigated and utilised in teaching and learning. Gee observed that people would engage with video games, accepting that they would at times fail, learn and try again. In many games the journey to complete the goal can be long and complex, however the design of games often successfully promotes persistence, resilience, skills acquisition and frequent self-assessment. As an educator Gee recognised these skills were of value, in fact essential, to a successful learning experience. The question was how could this process be transferred from a video game into an educational activity? Gee

(2006) identified thirty-six principles of learning that exist in the design of good video games. His hope was that by identifying these principles they could be applied within an academic environment. The principles were sub-divided into six categories: Learning and semiotic domains; Learning and identity; Situated meaning and learning; Transfer of knowledge; Cultural models and Learning as a social activity. These principles included the timely dissemination of information to learners, the importance of achieving the right level of challenge and the attraction of being able to personalise ones learning experience (amongst many others). These three areas alone reflect contemporary, fundamental principles in education, they are not unique to games design, however they demonstrate that inspiration can be taken from good game design to create good learning activities.

Another early proponent of games for learning is Katie Salen, the executive director of a non-profit design studio, the Institute of Play (IoP) set up in 2007. An organisation that recognised the importance of connected learning; learning taking place in a variety of places, formal and informal. The Institute of Play aimed to create learning experiences that were rooted in the principles of games design.

By 2009 the Institute of Play had designed and co-founded Quest to Learn, a school in New York whose core principles were centred on games design and play. To the extent that they had a design studio made up of game designers and curriculum designers who worked with academic staff, and students to create games-based activities for curriculum. The outcome is students whose learning is situated, interest driven and engaging.

The Institute of Play announced in June 2019 that the organisation would be closing. The acceptance of games and play into learning today is far more widespread that it was when the Institute of Play was founded and at least part of that is down to the resources and examples of good practice that came out of the organisation.

Although the conversations and interest around games-based learning may be more widespread, Larry Johnson, Samantha Adams and M. Cummins (2012) had predicted games-based learning to be in mainstream use within three years, based on research demonstrating its effectiveness for learning. However, the use of games-based learning in educational digital resources is not yet mainstream, partly due to a lack of understanding of how to integrate game mechanics within a sound pedagogical design (Arnab et al. 2014; Suttie et. al. 2012; JISC 2007; de Freitas 2006a). In the example of Institute of Play's Quest to Learn school the academic staff had the unique situation of an in-house design team. Through collaborating with this team they were able to approach their curriculum delivery with a design mind-set as opposed to the traditional knowledge transfer model that we see in standard classroom teaching. This level of support is not realistic in most academic settings right now. Instead there needs to be a way for staff to access this kind of design centre support from a distance; resources which will enable staff to confidently take steps to introduce small playful or games-based interventions. And most importantly access to a community of practice that is open to all.

Opinion has been mixed as to how beneficial the use of games-based learning is and whether it holds any advantages over traditional teaching methods. Meta-reviews have found games-based learning can have a positive impact on deep learning (Erhel and Jamet 2013, Vogel et al. 2006), whilst others have analysed the research and questioned these claims (Kebritchi et al. 2010). To confuse the issue further, it has also been suggested that the reason for this lack of agreement over the effectiveness of games-based learning is due to poor research design and a lack of comparable studies with good quality empirical data (All, Nuñez and Looy 2014).

This study will investigate the current uses of games-based learning in the Creative Arts and the benefits for creativity and collaborative learning that have

so far been claimed, while also collecting strong empirical data from which it will be possible to draw new insights and conclusions.

2.3.3 Current use of games-based learning in Creative Arts

Non-digital games have been in use for some time within the Creative Arts, albeit often through non-competitive play. For example, within Performance Studies games are often used that encourage group improvisation, character creation and the setting out of scenarios (Dixon 2001). Types of games include role-play games where 'Players are both actors and audience for one another' (Murray 1997: 42). Listening and storytelling games all providing a 'safe' environment for experimentation, shared discoveries and collaborative learning.

The following studies all highlight the potential of digital games-based learning to support Creative Arts education. Jim Playfoot and Ross Hall (2011) argue that games-based learning is important in fostering creativity, innovation and entrepreneurship. Jacky Chan et al. (2011) investigate the use of motion capture and virtual reality technologies for dance training. Whilst not specifically considering games, they find that students are motivated to achieve by including a scoring element in their tutor feedback, with learners excited by the prospect of competing against other student's high scores. Whitton (2010) named 'creativity' as one of six factors that led to greater engagement with games, either through creative problem-solving or in-game artefact creation. She found that the opportunity for players to be creative allowed them 'to become more immersed in the game and shape its direction' (2010: 146). Rebekah Colby and Richard Colby (2008) propose a writing course where student work is informed by play in the game *World of Warcraft* (WoW). The course is defined by game theory which informs writing pedagogy, enabling students to immerse themselves in a form of writing that extends the classroom

into game space, providing 'possibilities of discovery' (2010: 310) rather than the traditional teacher-led delivery. Cindy Poremba (2007) examines the use of games and their impact on the practice of photography. She recognises that the play structure of some games can assist in the teaching of photo-literacy and describes how players can gain understanding of how a photographic image is constructed, particularly useful for those studying photojournalism. *Pokemon Snap* (1999, HAL Laboratory/Pax Softnica) is used as an example of a game that can 'teach basic visual composition and ways of seeing' (2007: 56). Laurie Hicks (2004) sees play and finite/infinite games as tools that should be used in arts education to encourage students to cross boundaries, experiment and develop their creative practice. She goes so far as to say that 'play is at the heart of art education' (2004: 287).

Although we find numerous suggestions that games are inherently beneficial to creativity, examples of digital games or resources utilising game mechanics in Creative Arts subjects are rare. In many cases where games are claimed to have been used for learning in the arts it is in the use of virtual worlds or simulations rather than games or game mechanics per se. The use of virtual worlds in Creative Arts education, whilst not common, has nonetheless been explored with limited success. *Second Life* (2003, Philip Rosedale / Linden Lab) frequently appears in studies investigating the use of virtual worlds to aid learning, providing a space in which to interact with others, create and explore; however, it is not a game when using the definition drawn from Suits (2005: 10).

2.4 Games for collaborative learning

Collaboration between players is frequently encouraged by games, for example, the board game *Pandemic* (2008, Matt Leacock / Z-Man Games) and the multiplayer online computer game *World of Warcraft* (2004, Blizzard). Individual players often strive to improve their competency so as not to be

regarded as a hindrance to other players in a group instead as a valuable member of the team who aids in achievement of a goal. It is an obvious step therefore to consider the use of collaboration in games as a tool to support collaborative learning. The 2012 Horizon Report stated the 'greatest potential of games for learning lies in their ability to foster collaboration and engage students deeply in the process of learning' (Johnson et al. 2012: 7). Research regarding the use of games and games–based techniques in education frequently supposes the idea that games-based learning can support collaborative learning (Whitton 2010; de Freitas 2006a; Romero et al. 2012).

The theory behind the pedagogical approach of collaborative learning stems in part from work by Russian psychologist Lev Vygotsky (1978). Considered controversial at the time and with some of his works incomplete due to his death at 38 years old, Vygotsky's theories regarding child development and education did not become widely accepted until the late 1970s. Today his work around the 'Zone of Proximal Development' and his thoughts on 'sociocultural development' are used to demonstrate the benefits of sociocultural interaction on cognitive development. Collaborative learning is based on the premise that learning happens far more effectively in a social context through interaction rather than in isolation. Within this pedagogy, teachers are often positioned as facilitators or guides who enable students to work with each other, either face-to-face or digitally, in order to build knowledge and explore the subject area. Research over three decades has found pedagogical benefits of collaborative learning over individual learning to include increased critical thinking, improved reflection, better communication skills, motivation (Johnson et al. 1991; Bruffee 1998; Cecez-Kecmanovic and Webb 2000), and complex problem solving (Kirschner 2008). Networked technologies have allowed for a greater extension of the social interaction required for collaborative learning; students can now create, share, participate not only with their peers but also with those in industry, in real time where required, using a variety of media and in a myriad of ways, from wikis and blogs to soundscapes and games. A large body of

research debating and supporting the use of technology in education to foster collaborative learning can be found in the journal of *Computer Supported Collaborative Learning* (CSCL). Technological mediation is not a panacea for collaborative working, there are barriers to entry including digital literacy, access to hardware, accessibility and differing motivations for those that engage, which must be considered as with any sociotechnical system. Yet when these challenges are addressed technological platforms can bring with them many opportunities to enable collaboration. Video games are one example of where technological advances and the ability to create networked communities are resulting in increased opportunity to work together. Increasingly we are seeing more examples of mainstream commercial games utilising collaborative systems, creating situations where players require input from others in order to achieve a goal.

- In Massively Multiplayer Online Role-play games (MMORPGs) such as *World of Warcraft* (2004, Blizzard), groups of players form 'guilds' and can take part in complex, time-consuming 'raids', with content only accessible to those playing as a team
- There is a trend within First Person Shooter (FPS) games towards team-based game play rather than one-on-one 'deathmatch' style modes: examples include *Call of Duty* (2003, Activision) and *PlanetSide* (2003, Sony).
- Many ostensibly single player games such as *Portal 2* (2011*,* Valve) and *Warhammer 40,000: Dawn of War 2* (2009, Relic Entertainment / Feral Interactive) allow access to new content via two or more player cooperative modes

All these examples motivate players to collaborate with others by offering experiences that would otherwise be unavailable to them. Through functioning as part of a team, players develop an awareness of how their actions impact on

the success or failure of the group objective. Inadvertently players develop their communication, critical analysis and problem-solving skills through collaborating with other team members. This experience reflects the skills that are often developed through the process of collaborative learning. Although more empirical research is needed, an increasing number of studies have considered utilising games to enable collaborative learning.

Iro Voulgari and Vassilis Komis (2008) focus on using Massively Multiplayer Online Games to design environments that enable effective learning through collaborative problem solving. They discovered that players usually only collaborated if required to, and that individuals would often attempt to solve problems by themselves first. Voulgari and Komis concluded that the games' mechanics needed not only to encourage but also to require interaction in order to complete problems and meet goals.

Whitton (2009) and Christian Reuter et al. (2012) demonstrate the potential of adventure-games for collaborative group work. Whitton developed two collaborative game-based activities, one, a translation of a more traditional classroom based activity, *The Time Capsule*, and the second, a multi-player adventure game, *The Pharaoh's Tomb*. Whereas *The Pharaoh's Tomb* provided team-scores allowing for measured outcomes that could be compared between teams, *The Time Capsule* had no measured outcome or scoring; teams either completed the goal or did not. Each activity had the same learning outcomes and timeframe for completion. 78 students took part in the main study, which formed part of the core curriculum. Learning was evaluated using self-perception questionnaires. Participants in both activities perceived learning to have taken place, however the study found no significant difference between the two games in self-reported learning or engagement. Whitton acknowledges that the self-reporting of learning was not the most robust method of assessment, yet it was used due to issues regarding the time available and the

possibility of influencing subsequent learning with additional testing. She posited that if these issues could be overcome, a larger test population using pre-tests and posts-test at intervals would provide more robust data.

Reuter's (2012) prototype was based on isolated problem solving, unrelated to specific learning outcomes. The focus of the game was on puzzle solving: its graphical, narrative and audio elements were purposely basic. The game was trialled in two different settings, one with players able to talk to each other in the same room, playing over a local area network (LAN) the other with players communicating only through text chat, online. In both scenarios, players seemed to collaborate well to solve puzzles, unsurprisingly those using only the text-based communication used double the playtime compared with their counterparts. The study concluded that this demonstrated the potential for using games in collaborative learning – yet there still needed to be the inclusion of 'real learning content' with extensive evaluation in order to fully assess the effectiveness.

Margarida Romero et al. (2012) investigated the literature regarding the use of multi-player games to support collaborative learning and the impact of intragroup dynamics and scenarios on learning. The study concluded that in multi-player environments students needed support with intragroup interdependence and collaborative working. A series of recommendations to meet the challenges of developing these types of activities were provided which included drawing on the research of Computer Supported Collaborative Learning, ensuring students are provided with a full set of communication tools and concentrating on 'the importance of intragroup cooperation and the sense of belonging' (2012). Their study found that it was the careful consideration and implementation of tools and guidance to support collaboration that ensured learning outcomes could be better guided through the activity.

2.5 Collaborative learning

Collaborative learning is based on the premise that learning happens far more effectively in a social context, through interaction rather than in isolation. The theory behind this pedagogical approach has been influenced by psychologists Lev Vygotsky and Jean Piaget, as well as philosopher John Dewey, who each investigated the benefits of sociocultural interaction on cognitive development and experiential learning.

Collaborative learning is guided by the concept that learning is, in Piagetian sense, a constructive activity; in collaborative learning students are working together to construct knowledge, dissect and test theories and form a body of work or solve a puzzle based on their collected findings. Piaget's theory of Constructivist Learning advocates that humans construct knowledge and meaning through their experiences (Ginsburg and Opper 1969); this idea underpins approaches to collaborative learning. In a social constructivist learning environment, the traditional notion of teaching whereby the tutor transmits knowledge to passive students expected to retain and repeat, is seen as hindering the natural learning process. Instead teachers are often positioned as facilitators or guides who enable students to work with each other, either face-to-face or digitally, in order to build knowledge and explore the subject area (Wilson 1996). Not all constructivist learning environments will require students to work collaboratively, however for Piaget all collaborative learning activities are constructive in nature.

Comparisons are often drawn with cooperative learning, and there are similarities in the sense that students are encouraged to work interdependently with guidance from a tutor. However cooperative learning requires group

members to divide tasks between them, whereas collaborative learning involves a group working together to find solutions and achieve a goal (Paulis 2005).

The benefits of collaborative learning have been found to include the development of various interpersonal and personal skills such as leadership, decision-making, critical thinking and communication (Bruffee 1999; Whitton 2009; Goodsell 1992), as well as developing an understanding of different learning styles and managing different expectations or approaches. The success of a collaborative learning exercise lies in the existence of positive interdependence within the group, which in turn ensures there is shared responsibility and a sense of commitment (Goodsell 1992; Kagan 2007). Positive interdependence ensures that students are reliant on each other in order to complete the task successfully and that there is a 'positive correlation of student outcomes' (Kagan 2007). Collaboration requires the acknowledgement of the strengths and weaknesses of both oneself and others. Whether the outcome of a collaborative learning experience is that of a shared creation or of a shared discovery, the process that led there will have exposed students to a process where vulnerability and empowerment co-exist.

Increasingly, and in part due to the development of a networked society, there is the possibility to provide students with opportunities to work and problem solve with others, both within and outside of academia. Functionality exists to enable group working within Virtual Learning Environments at most schools, colleges and universities, there are opportunities within groups on social media sites such as Facebook and in games such as Massively multiplayer online role-playing games (MMORPGs) that require players to work together to achieve a set goal. The growth of open collaboration projects outside of the academic institution means many students have benefitted from the outcomes of collaborative working without necessarily being aware or recognising it as such. Wikis, the availability of open source software and open mapping projects are just a few examples of open collaboration systems that are commonplace

online. These mechanisms currently allow students (and others) to be authors, contributors, and collaborators, forming, as Henry Jenkins et al. (2006) termed it, a 'Participatory Culture' in which the potential for creative expression and collaboration is immense.

Working together clearly encourages creativity, and ostensibly democratizes the way knowledge is shared. The pedagogical justification for collaborative learning is compelling and there is documented evidence of the potential for digital games-based activities to support this. How this can be of specific benefit to the Creative Arts is the concern of the following section.

2.5.1 Collaborative learning in the Creative Arts

Research regarding collaborative learning has referred to the benefits that this pedagogic style can have on student creativity. Collaboration between students has been found to be beneficial whenever 'divergent thinking or creativity is desired' (Johnson et al. 1991: 55); it has also been shown to enhance critical thinking (Gokhale 1995). Working together and partaking in an exchange of ideas enables creative discourse, encouraging students to author, create, be interactive, improvise, compromise, and ultimately to challenge their own practice. Interdisciplinary collaboration and co-creation especially can provide a rich learning experience requiring learners to manage 'the uncertainty and ambiguity of creative practice' and challenge subject conventions (Alix et al. 2010: 14). Importantly, some arts by their very nature tend towards collaborative practice, for example, theatre and music. We can look to opera, musicals, and theatre companies such as Complicite or Kneehigh, to see these two disciplines in deep collaboration. However, this does not necessarily translate into opportunities for collaborative learning in higher education. Helena Gaunt & Heidi Westerlund acknowledge that 'music-making is rarely a

solo affair' (2013: 2) yet the delivery of knowledge and tuition at all levels of ability is often a one-to-one process.

Additionally, the importance of enabling collaborative learning in the arts is written into education policy. The Quality Assurance Agency for Higher Education (QAA 2008) Art & Design subject benchmark statement specifically identifies collaboration as being required of holders of an arts honours degree. One reason stated is so that students appreciate and develop the skills required for industry or professional practice. The Higher Education Authority (HEA) published a study in 2010 from the PALATINE project, a study on the Pedagogy of Collaborative Practice in the Arts in HE (Alix et al. 2010). The project sought to observe and develop pedagogical approaches to collaborative practice, collecting data via an online survey from 19 different arts higher education institutions. Information was gathered about how the modules were taught, how work was assessed (assessment type and weighting), how collaborative groups were formed, and the types of collaborative working patterns that were observed.

Respondents noted that delivering this method of teaching was easier when modules were taught collaboratively with other colleagues. Where the lecturer had experience of 'interdisciplinary collaborative practice alongside their own discipline' (Alix et al. 2010: 12) they were able to support the delivery of the skills required for successful collaboration more effectively. Two different pedagogical models were put forward for consideration in the study. Both were Oppositional Models that were intended to offer contrasting approaches to the collaborative learning experience. Model 1: 'Striated and Smooth' considered the merits of a 'Striated' or highly organised approach, where problems are pre-empted and the student experience is very structured, versus a 'Smooth' or fluid approach, where students and staff 'generate the structures and experiences as they go'. Model 2: 'Complementary and Integrative', confronts

the differences in collaborative work where a student may work only in their own discipline alongside others (Complementary) or where the discipline boundaries are blurred and students work across them. I will refer to these models as part of the design of collaborative games-based activities in this study (Chapter Five, p.107) in order to guide the pedagogical approach used.

The Guildhall School of Music and Drama in London have provided opportunities for students from the two disciplines of theatre and music to collaborate on projects, both curricular and non-curricular (Ford and Sloboda 2013). Collaborative projects included (i) the realization of a play with an accompanying musical score; (ii) the realization of a play text with newly composed music, where the music was first improvised by music students and then reworked by a composition professor; (iii) the devising by students of both play and music around folk narratives; and (iv) a series of student devised musical stage sketches with no pre-agreed narrative, but sharing a common theme. Ford and Sloboda noted how music and drama students considered the audience and their text, with musicians reporting benefits including being more aware of their audience and an increased opportunity to react in the moment due to the audiences' unfamiliarity with the content. This was in direct contrast to their prior experience performing well-rehearsed and well-known classical pieces.

Ford and Sloboda suggest that 'Collaboration challenges all parties to negotiate artistic values and practices' (2013: 28) and the studies cited above on interdisciplinary collaboration support this. In addition to the development of skills traditionally associated with collaborative learning in the Creative Arts sector, skills such as improvisation, visualisation and conceptualisation are also core. Activities to encourage collaborative learning in the arts need to be designed with the development of these skills in mind.

2.5.2 Assessment and collaborative learning

We know that when students partake in collaborative learning the necessary interpersonal exchange that takes place allows them to 'express, share, and test [their] creative instincts' (Livingstone 2010: 60). Despite these intrinsic benefits to those studying Creative Arts subjects, Assessing Group Practice, a HEFCE funded project in 2002, found that the higher education sector in the UK was not fully capitalising on or assessing collaborative skills that students obtained through arts study (Adkins 2002). Since that piece of research further studies have been conducted into the nature of collaborative learning and assessment, highlighting challenges and complexities that need to be considered when designing assessment methods for group-based work and collaborative projects. Collaborative projects using digital technology frequently allow assessors greater insight into the exact nature of what each individual has contributed, invaluable when assessing group work.

Collaborative learning frequently involves an element of group work and therefore group assessment. This is a type of assessment that can be seen negatively by some students (Falchikov 2005; Orr 2010; Volet and Mansfield, 2004). Communicating the idea that assessment is being used for learning rather than simply 'assessment for measurement' (Cartney 2012: 61) can help to encourage all students within the group to take an active role towards group assessment activities. Moreover, assessment techniques such as peer assessment can support this idea and aid students with using and implementing the feedback received. Engaging in a peer review process can help students to develop their understanding of the Intended Learning Outcomes and the Assessment Criteria, particularly important in a group work scenario. Peer review can be a useful tool to support assessment of group working. In addition to the single mark attributed to an individual's contribution, students can be

asked to provide an anonymous peer mark for each individual member of their group. They may be encouraged to assess the overall group interaction as well as the individual's contribution to the work load. As long as clear guidelines, ideally drawn up with students beforehand, are available this method of using peer review in conjunction with traditional assessment can provide both motivation and clarity around the purpose of the activity for students.

A particularly relevant case study by Sarah Orr (2010) investigated undergraduate student and staff experiences of group work assessment in the subject areas of theatre, dance and film at York St. John University. The study started from a 'perspective that assessment is a complex social practice' (2010: 303) that impacts the way in which students interact with both each other and their lecturers.

For lecturers, assessment was very much seen as a qualitative process, rather than quantitative. It was not so much about the size of the contribution to the group work by an individual but the 'quality and appropriateness of the work that is valued' (2010: 306). Yet Orr's sample of students frequently viewed assessment quantitatively as demonstrated by the oft-repeated phrase 'I did more than him/her' (2010: 306). The method of assessment that lecturers chose also seemed to cause unease with some students. Inevitably much of the assessment process was through the medium of written pieces, whether journals, evaluations or production documents that effectively described developmental process. In reflecting on this, Orr referred to Smart and Dixon's research, which suggests that 'those who are best able to articulate the collaborative and performance process in a written form might gain an advantage even though their creative contribution may have been poor' (2002: 192). As well as considering how lecturers managed the assessment process, Orr also noted how students experience that process and their understanding of what constitutes 'fair' assessment. There was disagreement among students as

to a ‘fair’ way of assessing group work and the issue of non-contributing students. Part of this issue was the differing concept between students of what constituted ‘fair’. Some felt that for marking to be fair and consistent the whole group should receive the same grade for a piece of work, whereas others felt that individuals should be marked separately so to recognise differing contributions. This challenge points to a disjunction between the end product created by the group and the individual nature of the degree award, which each student is working towards. Concerns regarding fairness were also mentioned by students in relation to their reflective writing and how accurately they portrayed difficulties within the group. Orr found that some students ‘felt it was important to present a united front to the lecturers’ and others didn’t want to ‘disadvantage another student’ (2010: 308–9). Conversely there were those who felt the group dynamics and contributions should be accurately described, that you had to ‘fight for your mark’ (2010: 309). The study found a possible relationship between the trust students had for others in their group and the level of risk-taking of concern, considering the general notion that risk taking is key to creativity (Orr 2010). Although it examines a small sample, Orr’s study provides an insightful exploration of the group work experience through the eyes of students and lecturers. This work is particularly relevant to the design of assessment approaches in creative collaborative practice and the recommendations made by Orr will be referred to in the group activity assessment design within this research.

2.6 Learning outcomes

The impact of any games-based techniques needs to be measured against specific learning outcomes. For this to be possible any activity that includes game-based techniques must be designed with the students’ learning experience in mind, not just their enjoyment or engagement with the activity. The mechanics used need to be appropriate for the pedagogic approach

proposed, the subject area, the intended output of the activity (e.g. in the arts, the output would involve the creation of an artefact), and the desired learning outcomes. Moreover, the only way to know whether any of these goals have been successfully reached is with the implementation of a robust evaluation process.

Measuring the impact on learning outcomes of using digital game-based techniques in educational activities is at best hazy and at worst completely omitted in much of the current games-based learning research. Frequently project evaluations consider student reactions to and satisfaction with an activity as measures of success rather than gathering evidence regarding the attainment of learning outcomes. Jennifer Vogel et al. (2006) undertook a meta-analysis and observed significant cognitive gains across studies utilising game and games techniques however these 'cognitive gains' were not defined, neither was there information about how these are measured. While there is evidence that games-based learning *can* have a positive impact on engagement and motivation (Prensky 2001; Sabourin and Lester 2013; Erhel and Jamet 2013), Carlo Perrotta et al. conclude that more research is needed in this area as the 'strength of evidence has been affected by research design or lack of information about the research design' (2013: ii).

Gathering data relating to how well learning outcomes have been met has been a persistent challenge for educational researchers. Jody Fitzpatrick, James Sanders and Blaine Worthen (2004) acknowledge the difficulties in this area and identify almost 60 different models used between 1960 and 1990 alone in projects attempting to measure achievement of learning outcomes. Many of those models were not based on any theoretical framework that might help to explain how their conclusions were reached. Particularly in games-based learning research, a contributing factor towards this lack of evidence is a misplaced focus on the perceived novelty of using games-based learning

compared to traditional 'chalk and board' instruction. The focus on student satisfaction obscures the fact that, as with traditional methods of teaching, it is primarily the success in meeting learning outcomes that determines whether games-based learning is effective in education: 'Measures should include both learning outcomes (knowledge transfer including cognitive and skill-based abilities) and engagement (affective learning experience)' (Arnab et al. 2014). Furthermore, most digital games-based learning studies have not been conducted over substantial periods of time, in part due to it being a relatively new method of teaching that has not been accepted into the mainstream. Clearly there needs to be more consideration given to this aspect of the empirical study of games-based learning and a level of agreement and consistency on how academic achievement should be measured in order to enable outcome comparisons across studies.

Sara de Freitas & Martin Oliver (2006b) introduced a Four-Dimensional Framework (4DF) aimed at enabling the implementation of games-based learning and simulations to support a 'traditional learning context' (See figure 2-1). Their paper emphasised the differences between the study of learning and motivation in leisure games to those specifically designed for educational use.

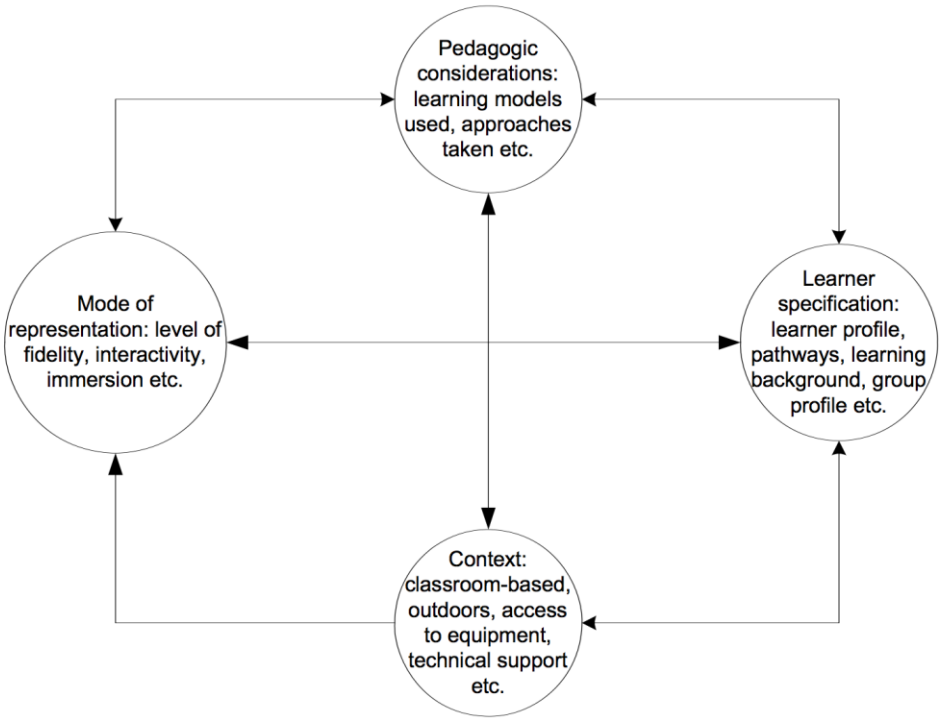

Figure 2-1: Framework for evaluating games and simulation-based education (de Freitas & Oliver, 2006)

This model places great significance on the internal representational world of the game or simulation being used. Immersion in the game world and its impact on the learning process is a key point of investigation within this model. Whilst the dimensions of pedagogic considerations, learner specification and context will all need to be considered within the framework developed in this study, the nature of the digital activity created will not aim to immerse students in a game-world or simulation. Therefore, although de Freitas and Oliver proposed a model that has been proposed to support games-based learning it will not be used within this research.

Sylvester Arnab et al. (2014) proposed the use of a 'Learning mechanics Game Mechanics (LM-GM) Model' to support the analysis and pedagogically sound design of Serious Games. The model they designed may support the

implementation of specific game mechanics to address learning outcomes and the ability to replicate successful studies. A case study using a third person shooter game, *Re-Mission,* demonstrated how the model may be applied, enabling the identification of core principles to the game, the required learning goals and the relationship of the specific game mechanics to the aforementioned. Figure 2-2 shows the game play loop and the related game mechanics that were identified using the LM-GM model.

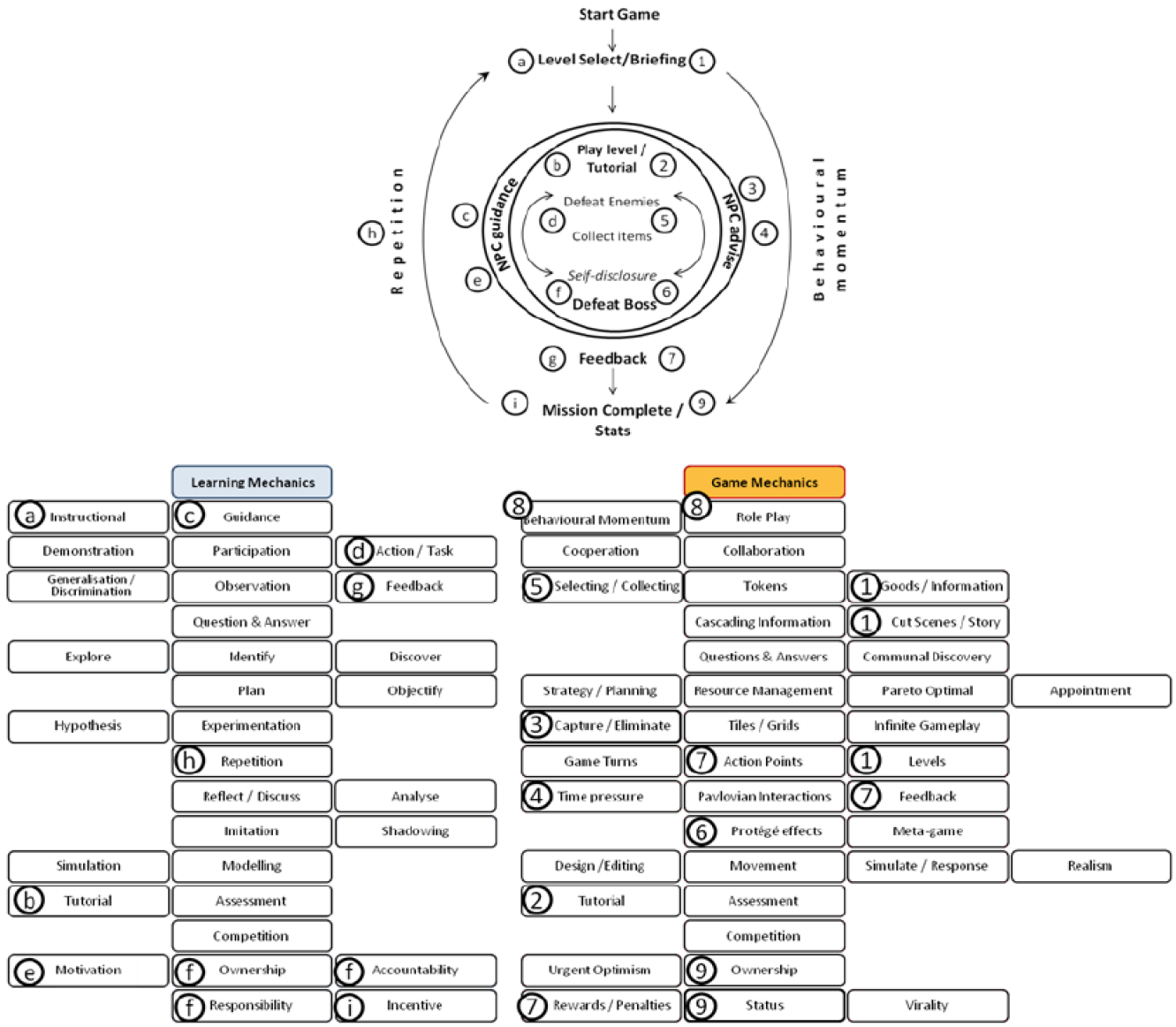

Figure 2-2: A game map visualising the LM-GM based analysis of Re-Mission (Arnab et al. 2012)

Although this demonstrates the LM-GM model being applied to a game rather than an activity making use of games-based techniques, it is flexible enough to be adapted for this Creative Arts context. Importantly, the LM-GM model has been designed with Bloom's Taxonomy in mind and an awareness of the consideration that needs to be given to both game mechanics *and* learning mechanics. This model will be referred to in further detail within the design of activities within this research.

While digital games have been used to enable collaborative learning in STEM subject areas there is little use of games-based learning to aid collaborative learning in the Creative Arts. This chapter has explored the idea that games encourage creativity and has gathered evidence demonstrating the benefits collaborative systems can bring to the game-play experience. It has also outlined how collaborative work can influence the development of creative practice, enable students to reflect on the diversity of ways collaboration is undertaken in the arts, as well as providing a good foundation for working in industry, beyond education. Yet this review of existing literature has found no evidence of games-based techniques being used to enable collaborative learning specifically for Creative Arts students. Given the research outlined above it is essential that this gap is bridged in order to support those who wish to capitalise on the potential benefits of implementing games-based learning activities to support collaborative learning in the Arts. This study aims to fill this gap through the development of a conceptual framework, the identification of specific game mechanics to support specific learning outcomes and the implementation of an activity incorporating games-based techniques. These steps will be designed with specific attention to the Creative Arts subject area, resulting in a body of research that will provide a foundation from which the effectiveness of games-based learning in the Creative Arts can continue to be explored.

3 Research Design

This chapter outlines and explains the methodology and research design of this study. First, it sets out the methodological approach that the study takes and explains why this approach was chosen. This is then followed by an overview of the research techniques that have been implemented, their general value and attributes. Finally, there is a discussion of the ethical considerations that have arisen as a result of this research.

3.1 Methodological approach

The research undertaken for this thesis uses Design-Based Research (DBR). This is a methodology that is commonly used within learning sciences research and it is Constructivist in nature. So frequent is its use in educational contexts that the methodology is also known as 'Educational Design Research' (EDR). It is suitable for studies that take place in a naturalistic environment as opposed to a controlled context. It claims to characterise situations as opposed to controlling all variables. As Barab and Squire explain, 'Design-Based Research involves flexible design revision, multiple dependent variables, and capturing social interaction'. (2004: 3)

A Design-Based Research approach was chosen because its methodology is specifically concerned with looking at studies in an educational setting to develop and thereby contributes towards pedagogical theory. Those students involved in the study are active participants who are consulted rather than treated as passive subjects: they contribute to the design through their participation and feedback. Academic staff act as partners in the context of this method, ensuring that the study's methods can effectively be embedded within current practice; it is important staff feel some ownership in the activity they may be being asked to implement within their teaching. This approach is not unlike formative evaluation in terms of process, however Design-Based Research differs in that it is not concerned with simply confirming theory but also with the generation of theory. As well as

making an impact in the local context, Design-Based Research studies seeks to contribute towards the wider theoretical field as well as to advance pedagogical models.

> Design-Based Research requires more than simply showing a particular design works but demands that the researcher … generate evidence-based claims about learning that address contemporary theoretical issues and further theoretical knowledge of the field (Barab and Squire 2004: 5)

The fundamental characteristics of Design-Based Research, as outlined in Figure 3-1 (Wang and Hannafin 2005: 8) guide the selection of research methods and the manner in which an experimental prototype is implemented and managed.

Characteristics	*Explanations*
Pragmatic	• Design-based research refines both theory and practice. • The value of theory is appraised by the extent to which principles inform and improve practice
Grounded	• Design is theory-driven and grounded in relevant research, theory and practice. • Design is conducted in real-world settings and the design process is embedded in, and studied through, design-based research.
Interactive, iterative and flexible	• Designers are involved in the design processes and work together with participants. • Processes are iterative cycle of analysis, design, implementation, and redesign. • Initial plan is usually insufficiently detailed so that designers can make deliberate changes when necessary
Integrative	• Mixed research methods are used to maximize the credibility of ongoing research • Methods vary during different phases as new needs and issues emerge and the focus of the research evolves • Rigor is purposefully maintained and discipline applied appropriate to the development phase.
Contextual	• The research process, research findings, and change from the initial plan are documented. • Research results are connected with the design process and the setting. • The content and depth of generated design principles varies. • Guidance for applying generated principles is needed.

Table 3-1: Characteristics of Design-Based Research (Wang and Hannafin 2005: 8)

Design-Based Research involves the analysis, design and evaluation of a problem and its solution. This process can then be repeated as many times as is required until a satisfactory conclusion is reached or some other constraint halts the process. During the analysis stage, stakeholders associated with the problem will be consulted before moving onto the design process that will involve taking available theoretical information into account. Evaluation will include testing a new or amended design and observing whether it satisfies the initial rubric or problem. The cycle is then repeated. This process can be applied to longitudinal research that takes place over a number of years, or, for shorter, small-scale projects where

multiple iterations may prove valuable. There are many examples of Design-Based Research being used in educational research, however this study is particularly interested in cases where Design-Based Research has been used in research related to games-based learning.

Design-Based Research has been successfully used by Squire et al. (2005), who investigated the possibility of building an online gaming community specifically for learning. Squire's study acknowledged a low participant to facilitator ratio, partly down to the logistics of Design-Based Research, and the ability to observe and record the activity, as well as providing the support required to orient participants in a games-based environment. In this particular study as participants became more familiar with the environment it resulted in little to no support from the facilitators who transitioned to purely scaffolding activities and observing as opposed to assisting participation. Using a Design-Based Research approach allowed Squire et al. (2005) to regularly collect feedback and adjust the design and development of a model to support this type of games-based learning. Squire used the games-based learning research almost as a lens to examine Design-Based Research, highlighting that educational technology research does not have a great reputation for demonstrating impact and in addition using Design-Based Research as means to buck that trend. (Squire 2005)

One of the most valuable characteristics of using Design-Based Research is how it refers to the users with regards to design and creating further iterations. Koivisto et al. (2018) used a Design-Based Research approach when considering design principles for simulation games for learning in the context of clinical reasoning. From the set of highlights published (2018:1), two stand out as showcasing the benefits of using Design-Based Research. They surmised that, 'new knowledge on learning through playing evolves though iterative cycles' and they further suggest that 'successful game design depends on involving the intended user groups in the design process'. Both of these elements are foundational aspects of the Design-Based Research methodology.

Examples of Design-Based Research that have been implemented in games-based learning studies are not restricted to using just students as co-designers they have

also involved academic staff. Tobar, Baldiris and Fabregat (2016) recognised in their research that one of the barriers to implementing games-based learning activities is a lack of academic staff buy in. This is often for completely valid reasons, for example where there are low levels of digital capability, a lack of confidence with game design or purely a lack of time to investigate these things. However, in involving academic staff through a Design-Based Research approach, the researchers noted that staff 'gain interest and ownership on the final product while alleviating the burden of the actual development'. (Tobar, Baldiris and Fabregat 2016: 2).

These studies demonstrate the advantages that are gained by using a Design-Based Research methodology. The approach allows for experiments to take place in a 'live' rather than 'controlled' setting, subsequently the outputs are reliable and relatable, 'fit for purpose' and easily replicable elsewhere. It becomes easier for others to repeat the process in their own context, potentially adding to the data set as well as providing confidence that any findings will translate outside of the research study. This characteristic of Design-Based Research supports working towards the first aim outlined in this study, i.e. contributing to educational theory in the use of game mechanics in digitally-enabled learning experiences.

With the inclusion of both student and staff input, barriers to entry and ease of integration are considered. This makes Design-Based Research a socially responsible approach to conducting research. Additionally, the format of Design-Based Research is ideally suited to supporting another of this study's objectives: the creation of a series of experiments to measure the impact of game mechanics on learning outcomes. These experiments take the form of an iterative development of a games-based activity.

3.2 Selection of game mechanics

One of this study's research aims is to identify how individual game mechanics impact on specific learning outcomes. As discussed in the contextual review, the

impact of different mechanics on the achievement of learning outcomes can make the difference between a games-based activity supporting learners to achieve that outcome or the pedagogic intent inadvertently becoming a secondary concern to that of the game play. Aligning with characteristics of Design-Based Research ensures the design process is *grounded* (see Table 3-1, p.54); in this case the integration of game mechanics and forming their relationships to learning outcomes is underpinned by theory.

It is clear that the over-riding concept that a 'high level representation of pedagogical intent should be mapped to a low-level game mechanic implementation' (Arnab 2014: 4) can be applied to the design of any games-based learning activity. Here, we arrive at using Bloom's revised taxonomy to link game mechanics to a learning *process*. Bloom's revised Taxonomy (Krathwohl 2002) includes a hierarchical model that classifies learning outcomes and objectives into six different levels of cognitive complexity. These levels of cognitive complexity start with the lower-order thinking skills; knowledge, comprehension, application, and ending with the higher order thinking skills; analysis, evaluation and creation. Using Bloom's taxonomy we can articulate the high-level pedagogical intent and using Schell's categories of mechanics we have fields for identifying low-level game mechanics. Schell's categories are broad enough that they provide enough scope to consider games mechanics holistically, considering aspects such as the location (Mechanic 1: Space), and the collaborative skills of the participants themselves (Mechanic 5: Skills). These definitions of mechanics are rooted in a design philosophy as opposed to serving a purely technical purpose and are therefore applicable to a wider range of mediums and game types, not just digital games. For this reason, Schell's categories are particularly well-suited to underpinning the design of a locative, collaborative activity.

In order to analyse and map the game mechanics alongside the desired learning outcomes Arnab et. al's (2012) Learning Mechanic – Game Mechanic (LM-GM) model has been selected for use in this study. This model enables non-prescriptive, pedagogy-driven design and supports the designer to develop an understanding of

how the game mechanics can be utilised to transfer knowledge or develop specific skill sets. In short, relating 'pedagogy intentions and ludic elements' (Arnab 2012: 2) to support practice. By drawing the map, the researcher can visualise the relationship between mechanics and pedagogy, thereby avoiding a common failing of gamification. Frequently mechanics are chosen purely with game play in mind, with academic content almost seeming like a bolt-on, poorly integrated into the game itself and disrupting the flow of play. The result, claims Arnab, (2012: 4) is that 'consequently, learning occurs only tangentially'. A common sign that this has taken place is where game play is frequently interrupted to include large chunks of text where the learning content is delivered.

Once a set of learning outcomes have been identified these can be mapped to Bloom's taxonomy before being considered against a set of game mechanics. After the decision has been made which mechanics will best support which learning outcomes, the information can be coded and transposed onto an operational map of the game. The example below (Figure 3-2) is the resulting game map from a LM-GM-based analysis of *Re-Mission,* used as a demonstration of the model by Arnab et al. (2012). The letters at various points in the game play and design relate to different learning outcomes, the numbers to different game mechanics (see the relevant lists on the following page) and, in this example, they run in parallel.

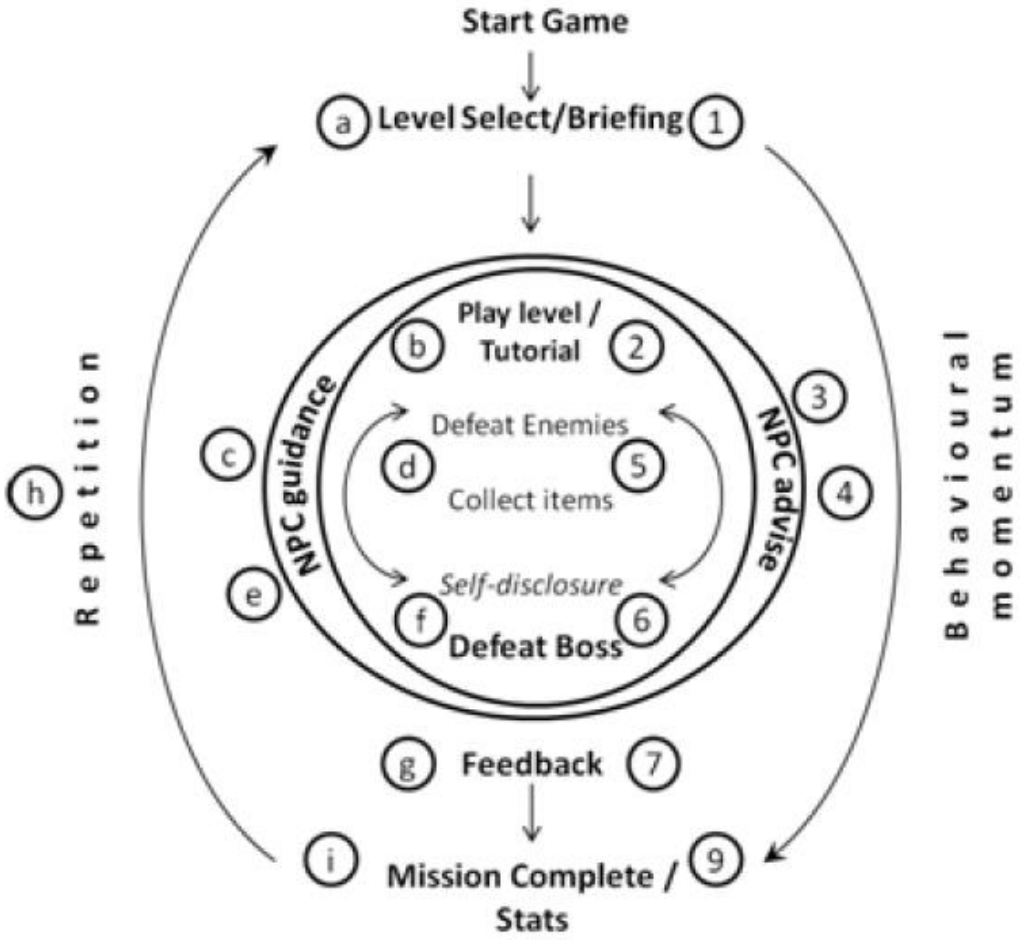

Figure 3-1: Game map from a LM-GM-based analysis of Re-Mission, (Arnab et al. 2012).

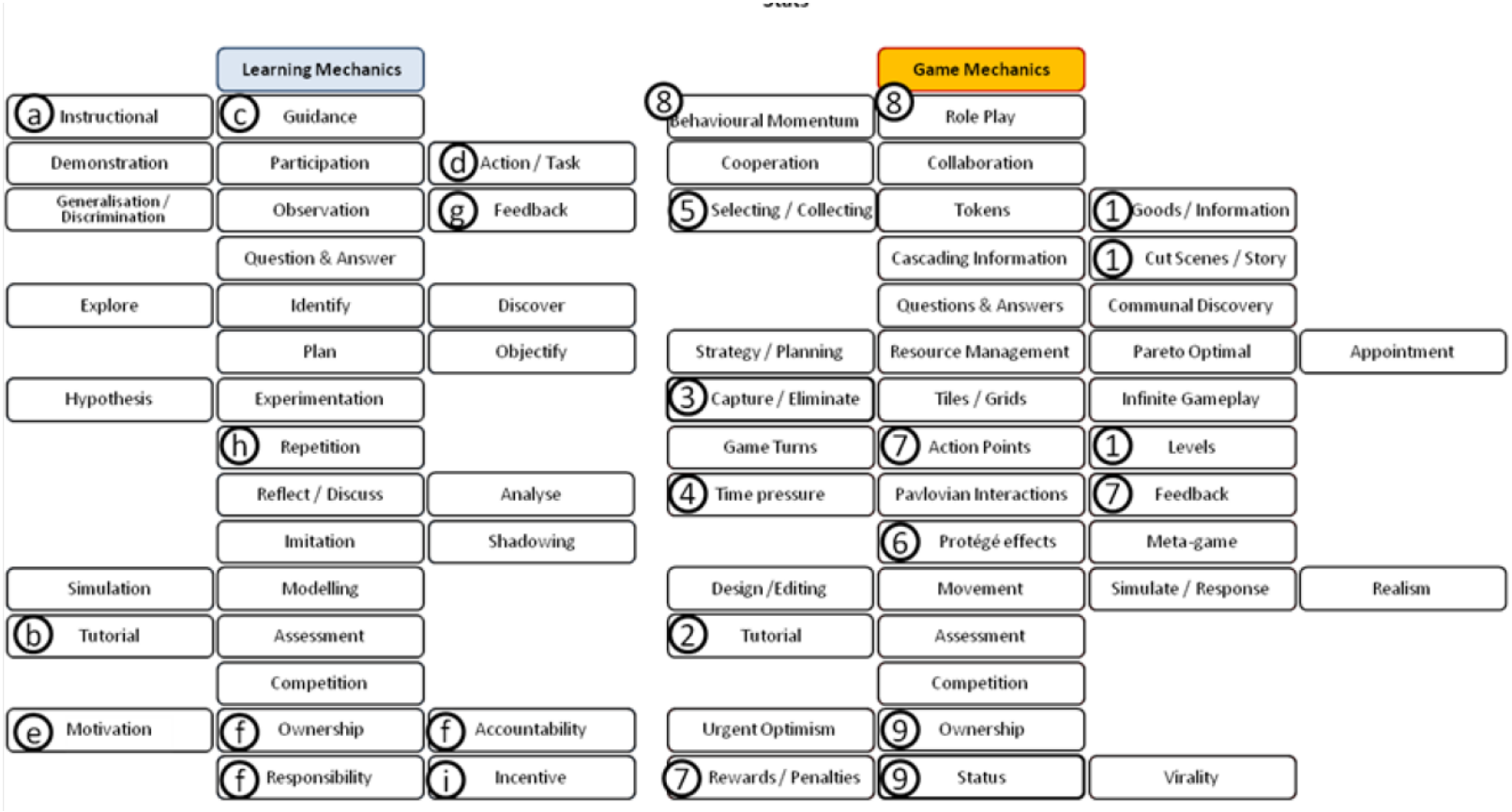

Figure 3-2: Outcomes and mechanics that correspond with the LM-GM map in figure 3-2 (Arnab et al. 2012).

This framework has been used in other games-based learning studies, including Callaghan et al.'s (2016) practical application of the LM-GM framework in engineering education. The authors found the ability to map and correspond the pedagogical elements to the game play allowed them to maintain a balance between entertainment and learning. The process forces the designer to include the learning as an integral part of the game.

Being able to visualise the relationships between the learning outcomes and game mechanics makes it clear to see when 'game-play and pedagogy intertwine'. (Arnab 2012: 5). As the author of this model has acknowledged, it is not a prescriptive approach. The mechanics used in Arnab's example above (figure 3-3) do not all fit with the definition of game mechanics that this study adheres to however. For example in this study 'urgent optimism' is considered to be a state of mind that can be affected by a game mechanic rather than a mechanic itself. The fact that this model is not prescriptive allows for the inclusion of game mechanics and learning outcomes that are specific to the activity being designed. Later in this thesis, the learning outcomes and game mechanics used for this study will be outlined using this model; those selected have been considered through the lens of collaborative learning.

3.3. Collecting data

At the time of this study's literature review there had been various claims that games-based learning can support collaborative learning, however there was no evidence on which to base this in a Creative Arts context. An empirical method has been chosen for the study in order to respond to both research and practice, which is also following the principles of Design-Based Research by using mixed methods and being integrative.

Evidence gained through observation and experimentation will be used to evaluate the effectiveness of game-based techniques on interdisciplinary collaborative learning. This evidence will also form the foundations for future design and implementations of games-based activities in the Creative Arts.

Phase of study	Type of data collection
Phase One	Desk-based scoping study
Phase Two	Semi-structured interview with seven academic and professional services staff
Phase Three	Experimental prototype – three instances with a total of eleven students (group one = 5, group two = 3, group three = 3).

Table 3-2: Phases of data collection

Phase one: Desk-based scoping study

Initially a desk-based literature review was undertaken to discover the current use of games-based learning in Creative Arts subjects. Resources covered included peer-reviewed journals, conference papers, professional bodies' guidance (such as the QAA benchmark statements) and government publications.

Having a clear overview of the current state of use as reported in the available literature, a scoping study into the existing perceptions, expectations and knowledge around games-based learning in the Arts was required. It was decided that this was carried out via semi-structured interview, which made up phase two.

Phase two: Interviews

A total of seven academic and learning technology staff have been interviewed across a variety of Creative Arts subject areas from various institutions across the country. Invited via traditional media, social media and professional e-mail list-serve, this approach provides the opportunity to ask participants about their

experiences of both games-based learning activities and collaborative learning tools, including their awareness of developments in this area within their subject field. This lends a perspective from both academic staff who tend to implement activities with their students as well as Professional Services staff in educational technology teams who often support these activities or in some cases promote the adoption of them.

Interviews with academic staff aid the formation of a clear understanding of the types of learning outcomes that staff set for collaborative activities and how successful they have found previous experiences with collaborative group work or games-based learning activities to be.

The outcomes of this phase are considered in the design of the conceptual framework, the identification of suitable learning outcomes and the type of games-based activity which was then designed. These decisions are influenced by the perceived barriers and needs articulated in this second phase of data collection.

Phase three: Experimental prototype

An experimental prototype was implemented in phase three, an iterative development process was used with three instances of the games-based activity taking place. Group one consisted of five students, group two consisted of three students and group three consisted of three students.

On each release of the experimental prototype, observations of participant activity took place. Observation helps to identify early user experience issues such as user interface navigation, comprehension of questions and puzzles, challenge level of tasks and the success at instigating the skills required for collaboration. Observation also provides information from non-verbal signals such as body language and how participants interact with each other outside of the digital activity.

Data from observations informed subsequent iterations of the experimental prototype. In line with Design-Based Research principles, participants were involved in the design and development of the prototypes. Use of 'interventions

systematically to refine and improve initial designs' (Wang and Hannafin 2005) are a standard feature within Design-Based Research. These interventions are guided through regular consultation with academic staff and students that are supported by the methods outlined above. The data collected during the series of experiments has been analysed and responded to between each occurrence of the activity, resulting in an iterative approach to the development of the games-based activity as a whole.

Data taken from the use of the activity itself has provided insight into how long and how often participants interacted with the activity for; where they went (being a locative activity); how challenging situations may have been navigated; where collaboration came easily and instances where collaboration was less forthcoming. However these observations do not provide an insight into the experience as perceived by the participant, nor an evidenced impact on learning.

Often research tools use very narrow criteria from which participants can respond to. From the constraints of a yes/no choice to answering on scale, there is no opportunity to personalise a response. For the researcher this is convenient in terms of data analysis; uniform scales and responses lend themselves to statistical data. However, as acknowledged earlier, measuring impact of learning is a difficult and non-uniform process. This study is based around Social-Constructivist theory which assumes that learners bring their own experiences, knowledge and expectations. No two people will start from the same position of knowledge, neither will they have the same learning experience from an activity and the impact of learning will be different for all. Therefore, the tools required to measure this learning must allow for personable, rich, detailed data.

3.4 Personal Meaning Maps

One method that allows for this personalisation of data is Personal Meaning Mapping. A fairly recent data collection and analysis tool, Personal meaning mapping (PMM), was first used by Falk, Moussouri and Coulson (1998) within the

context of museum visitors. It was 'designed to measure how a specified learning experience uniquely effects each individual's understanding or meaning-making process' (Adams, Falk and Dierking 2003: 22). PMM was developed as a response to the lack of methods that could be used quickly, without significant participant instruction, for the collection and analysis of data that might demonstrate impact on understanding of a particular exhibition or experience. Although similar to Concept Mapping, PMM requires no knowledge of specialist terminology or understanding of how to construct a concept map. Additionally, the rubrics used to score concept maps are based on predetermined language and ideas, transposing the researcher's reality onto the participants. PMM positively encourages the participants to use their own language and terms. Using this method to assess learning allows for the idea that a 'specific learning experience will vary considerably depending on the individuals themselves and the social/cultural and physical context of the experience' (Adams, Falk and Dierking 2003: 22).

PMM involves providing learners with a piece of paper with a prompt or concept written on it. This word or prompt needs to be carefully chosen to elicit the desired response and collect meaningful data. In the case of this study the prompt will be '**collaboration'**. Learners are then invited to spend as much time as they would like writing down their feelings, associations and knowledge, connected with that prompt. The use of words, images and sentences, or any other form of expression on the paper is encouraged. Importantly there is no input from the researcher until learners' state they have completed the task, at which point the researcher may encourage participants to expand on what they have written or explain certain additions. This process allows for participants to 'articulate and negotiate their perceptions […] to provide specific understandings from their own cognitive frame of reference' (Adams, Falk and Dierking 2003: 23). Additional information may be recorded on the paper by the researcher but in the learner's own words. In the original use of this method, visitors to the museum were asked to revisit their PMM after the exhibition. In a games-based learning activity, participants can repeat the exercise after the activity has been completed, and, if desired, again at a later date. One of the benefits of using this method of evaluation is that the PMM can be

revisited multiple times over any length of time, meaning an individual's changing perception or learned knowledge can be tracked effectively.

There are successful examples of Personal Meaning Maps being used in a games-based learning context. The pilot study of *Future Worlds*, a game-based learning environment for sustainability education in museums, used PMMs as one of the methods for measuring the impact on visitor knowledge and experience. The exhibit integrates turn-based strategy games, interactive narratives, and surface computing tables to support collaborative explorations of environmental sustainability (Rowe et al. 2014). Similarly to this research the study used an iterative process and took a mixed methods approach, one element of which was the use of PMMs. The findings from the PMMs suggested that visitors' interpretations of "sustainability" improved in accuracy following their interactions with *Future Worlds*. This outcome would have been difficult, if not impossible to measure using observation methods alone. Other techniques that can be employed could be seen as invasive to the visitor experience if questioned during their visit or perceived as onerous if provided with questionnaires to fill out and return at a later date.

3.4.1 Examples of Personal Meaning Maps

Due to the autonomy given to participants, one individual's map may look very different to another. Some may have a lot of text, while others very little. Figure 3-3, below is a good example of a very simple text based PMM. It was generated during some research into how effective at knowledge transfer was a play called 'Where Have all the Sharks Gone'? (Harber 2014). The play was tasked with highlighting the issues around trophy fishing for sharks and why a catch-and-release method should be practiced. Presented to members of the public, the researchers were inspired by Faulks to use PMM as way to ascertain if audiences had learned anything from the play.

A random selection of individuals and small groups from the audience were asked to complete a PMM before the show, and then add to it afterwards. Each interview lasted a few minutes.

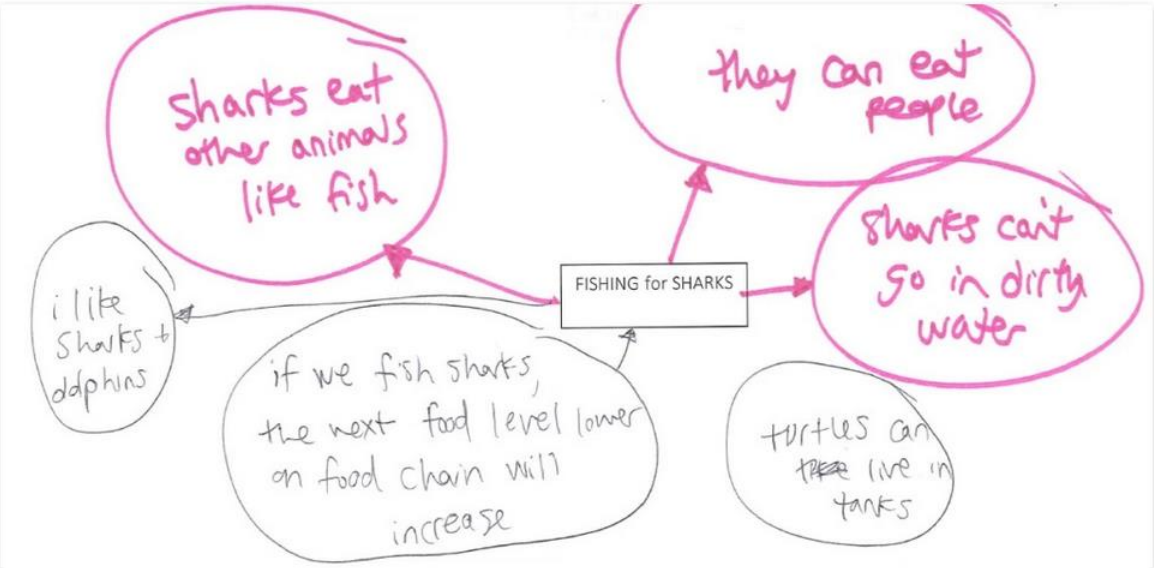

Figure 3-3: An example of a completed Personal Meaning Map. The pink circles represent responses before the play. The grey ones following the play. (Harber 2014)

The text written in pink circles are made from basic sentence structures and contain simple statements. The text that has been added after the show, whilst still allowing for expressions of opinions, ('I like sharks + dolphins') also includes a far more detailed and specific demonstration of knowledge. This participant made a general statement before watching the play that 'sharks eat other animals like fish'. The subsequent comment afterwards details what happens to the food chain when sharks are caught and shifts the earlier comment into more detail, demonstrating a deeper level of understanding.

3.4.2 Personal Meaning Map analysis

Figure 3-3 provides an example of a PMM that was quick to complete and analysis. This is not always the case and a PMM may be very text heavy, where participants

have been given more time and encouraged to contribute in a detailed way. Falk, Moussouri and Coulson (1998) proposed a method of analysing PMMs quite unlike the traditional analysis of concept maps, where scoring is based on a set of pre-determined fields and therefore starts from a supposition that there is a 'right' or 'appropriate' answer. PMM responses are analysed through four semi-independent dimensions; Extent, Breadth, Depth and Mastery with no pre-determined idea of what may be a 'correct' answer.

Dimension 1 – Extent. This is scored by looking at the quantity of relevant or appropriate words on the Personal Meaning Map, both before and after the learning experience. Appropriateness is determined by familiar or recognised terms associated with the key concept. It considers the extent of the learner's knowledge; asking how much relevant information they know and whether the experience changed this?

Dimension 2 – Breadth. By identifying various conceptual categories and looking at where learners have formulated their ideas into a concept we can begin to produce a score that is focused on the change in conceptual understanding of the subject.

Dimension 3 – Depth. This dimension considers how detailed the map is. This includes the identification of concepts, the complexity of the vocabulary and the number of words used, associated with the concept. It considers the 'tiers' of detail via connecting relevant vocabulary with identified concepts. Assessing the change in 'depth' between the pre & post activity maps can demonstrate whether participants have made the leap from knowing casual terminology associated with the subject matter to being able to describe a concept with appropriate terminology.

Dimension 4 – Mastery. A holistic overview of the entire map, this dimension looks at how complete the map is. Considering where on the scale between novice and expert the participant may be. The following four levels of mastery can be scored: (Harber 2014)

- Level 1 – Simple, novice-like understanding
- Level 2 – Intermediate level of understanding

- Level 3 – Proficient level of understanding
- Level 4 – Highly detailed, expert-like understanding

Characteristics to consider (as well as the previous dimensions) include the quality of the connections; the number of lines connecting ideas and thoughts on the map. For example, one point may be given for each legitimate link between areas on the map. In some cases, scores can be calculated by subtracting the number of irrelevant or inaccurate items from the number of appropriate contributions. In any study utilising this method the terms of scoring need to be clearly stated between multiple markers to ensure that each Personal Meaning Map has been evaluated consistently and with parity.

As the Personal Meaning Maps are analysed an increasing number of conceptual ideas will be identified, and the list of relevant vocabulary will grow. This allows for the learners' own language and meaning making to be expressed without fear that it will not adhere to a correct definition or pass rate. The particularly valuable aspect of using Personal Meaning Maps is that whilst allowing for this individuality the method can simultaneously illustrate the different learning gains made by individuals undertaking the same educational activity. The document is a developmental record of the learner's personal knowledge acquisition and construction.

In terms of benefits for the researcher, the flexibility and accessibility of this method make it suitable for use within a broad range of experiences where learning may take place and with a broad audience. Additionally, PMMs allow for a quick insight into a learner's knowledge acquisition, enabling an educator to determine whether an individual has retained information and understood in context, or whether further time may need to be spent on the subject. PMMs focus on the extent and quality of learning that has taken place, acknowledging that rich learning experiences can take place outside of formal classroom-based contexts.

Semi-structured group activity with students after the activity

Personal meaning maps can perform the function of providing two open ended interviews pre and post learning experience whereas a semi-structured group

activity allows for further exploration of knowledge and skills that have developed arising from participation in a collaborative learning experience. It can provide insight into the shared understanding that participants have of the learning experience, its purpose and whether it was thought to have achieved this.

3.5 Data analysis

A variety of methods have been used to analyse the mixed methods data collected.

Shirley Alexander (1999) outlines fourteen methods that could be utilised including pre and post-tests; questionnaires concerning students' perceptions of learning outcomes and interviews with staff. At least three of these methods have been used and the triangulation of the data gathered informs any conclusions drawn.

Content analysis of a group activity, interviews and Personal Meaning Maps, including scanning for word frequency and assigning categories, will be used to identify emerging themes. This has been undertaken at multiple stages so that identified themes can be investigated further and influence activity design, continuing the adherence to a Design-Based Research philosophy. This content analysis will be aided by computer assisted qualitative data analysis software (CAQDAS), NVivo, in order to categorise, analyse and identify key themes and cross-tabulation or grouping of data. The categories and themes arising from the semi-structured interviews are discussed in detail within section 5.1 of this thesis. Detailed analysis of the Personal Meaning Maps can be found in section 7.3.

3.6 Ethical considerations

This study has been approved in line with requirements set out in the Research Ethics policy at Falmouth University. Led by the ethical guidelines laid out by Falmouth University and University of the Arts London this author undertook research ensuring the legal rights, safety and wellbeing of all participants has been respected.

All participants are required to read and sign an informed consent form (see Appendix one) in order to ensure there is a clear understanding of why data is being collected and how it will be used. At no point were participants deceived for the purpose of the research or otherwise. Any information withheld regarding the activity from participants was necessary for the game to be played (for example, where exactly on campus they would be visiting), and any questions participants had regarding any aspect of the game, it's design or purpose were answered honestly and promptly by the researcher.

Participation was voluntary for all; this was clearly articulated to participants before undertaking the activity and was in no way detrimental to participants' studies. The activity was scheduled outside of timetabled or accredited study time and whilst the activity had its own learning outcomes these were not matched to a specific module. Therefore, participants were not put at a disadvantage or unfair advantage by taking part in the study.

Funding has been provided by Falmouth University covering various expenses within this study, including conference fees, provision of food and drink for participants, however there was no obligations or requirements attached to this or expectations as to how the data collected from the research should be used, other than informing this doctoral study.

Ethical considerations to be aware of include that of bias resulting from the Researcher-Designer role. Being involved in the design, development, implementation and evaluation of the study requires an awareness of researcher bias and the steps that can be taken to minimise this. In order to avoid bias affecting participant feedback in the activity, no examples of collaborative working have been provided to students before partaking in the Personal Meaning Map exercise or during the activity. Steps were taken to avoid selective recordings and the influence of participants to act in a certain way. Awareness of the observer expectancy effect is at the forefront in the design stage to ensure the researcher's belief in a hypothesis does not influence how the research or activity is presented to the participants. Research information sheets did not include the supposition that games-based learning is beneficial to collaborative learning. Measures have

been included to ensure that data is not skewed in favour of the hypothesis, for example a learner led activity and anonymised data collection. Similarly, the researcher is aware of confirmation bias. Subjectivity in research can be affected by a variety of external and internal factors. In this researcher's case, with a background as someone who enjoys games and working in Educational technology the personal subjective view is unsurprisingly optimistic about the beneficial uses of games-based activities in education. It is important to avoid confirmation basis; this perseverance to uphold a hypothesis with unjustified confidence. To not do so could mean the data is at best skewed in favour of the researcher's hypothesis, at worst corrupt and inaccurate. With sound research design and maintaining an awareness of the phenomenon this can be avoided. Using unambiguous language, asking open questions and analysing data with the assistance of software will all contribute to avoiding confirmation bias impacting on the research outcomes.

This chapter has introduced the methodologies that underpin both the research design and the research tools of this study. The purpose was to outline what these methodologies are, where they have been implemented previously and to demonstrate their value to this research.

The motivation for this researcher was to implement a responsive research design which resulted in choosing a Design-Based Research methodology to support this study. The design and development of the games-based activity has been driven by user needs, both academic and students, therefore the empirical methods chosen are presented with reference to the critical theory available regarding games, play and learning as outlined in the contextual review.

Also supported by findings from the contextual review, a design process has been identified which enables the mapping of game mechanics to learning outcomes, supporting the investigation of one of this study's principle research questions: the identification of specific game mechanics to impact specific learning outcomes in collaborative working. Additionally, having a clear map of the outcomes that can be achieved through the activity allows for the designer to clearly scaffold the learning experience throughout the activity.

The use of Personal Meaning Maps for recording participants' knowledge and experiences has shown to be a valuable tool in that it can allow the researcher to make assessments as to the impact on learning and knowledge that the learning experience has had. The flexibility of the format and opportunity for participants to contribute to their map in any way they feel comfortable is of particular interest to this researcher given that the study involves working with students from Creative Arts subjects.

Fundamentally the techniques outlined have been chosen with the value of an iterative process in mind. As discussed in this chapter there are many benefits to implementing an iterative design process and ensuring research techniques utilised are grounded within a Design-Based Research methodology. These benefits include (but are not limited to), allowing research to inform practice, learning from failings quickly to enhance further iterations and being able to evaluate the impact of small changes quickly. However, by far the most valuable and beneficial aspect of the iterative Design-Based Research methodology employed in this study is the possibility created for the involvement of participants to affect the design process and therefore the outcome. This creates an inclusive environment within the study and encourages participants to become engaged with the feedback process after the activity has ended and in the knowledge that they will influence design decisions.

The considered selection of these methodologies and techniques alongside adherence to the ethics guidelines available to the researcher has ensured this study is robust and fit for purpose.

4 A conceptual framework

One of this study's objectives is to develop a conceptual framework to support the development of games-based learning activities. The conceptual framework presented in this section has been developed to act as a roadmap that includes key stages from proposal to evaluation. It addresses key issues such as pedagogical approach and the desired learning outcomes, elements that are relevant to any subject area. It also considers methods suited to arts practice students, how they can use work that they have created as part of the process for their portfolios, or, as an alternative method, continue to work in a collaboration that extends beyond portfolio building activity.

The framework developed here is designed to inform my own empirical research, as well as to provide a toolkit for others working in the area; this represents the major contribution made by this doctoral study to current game-based learning academic inquiry. The framework I have developed is designed to ensure that the impact on learning outcomes is forefront in activity design as well as providing a useful model for evaluative discussion. Many frameworks that have been developed to support the creation of games for learning can prove to be daunting for those with little or no experience of games design or educational technology. The resource presented here is intended to be simple to follow and clear to understand. Each stage is backed up with sound pedagogical and technical evidence with signposting for those wanting to delve into any particular section in more detail.

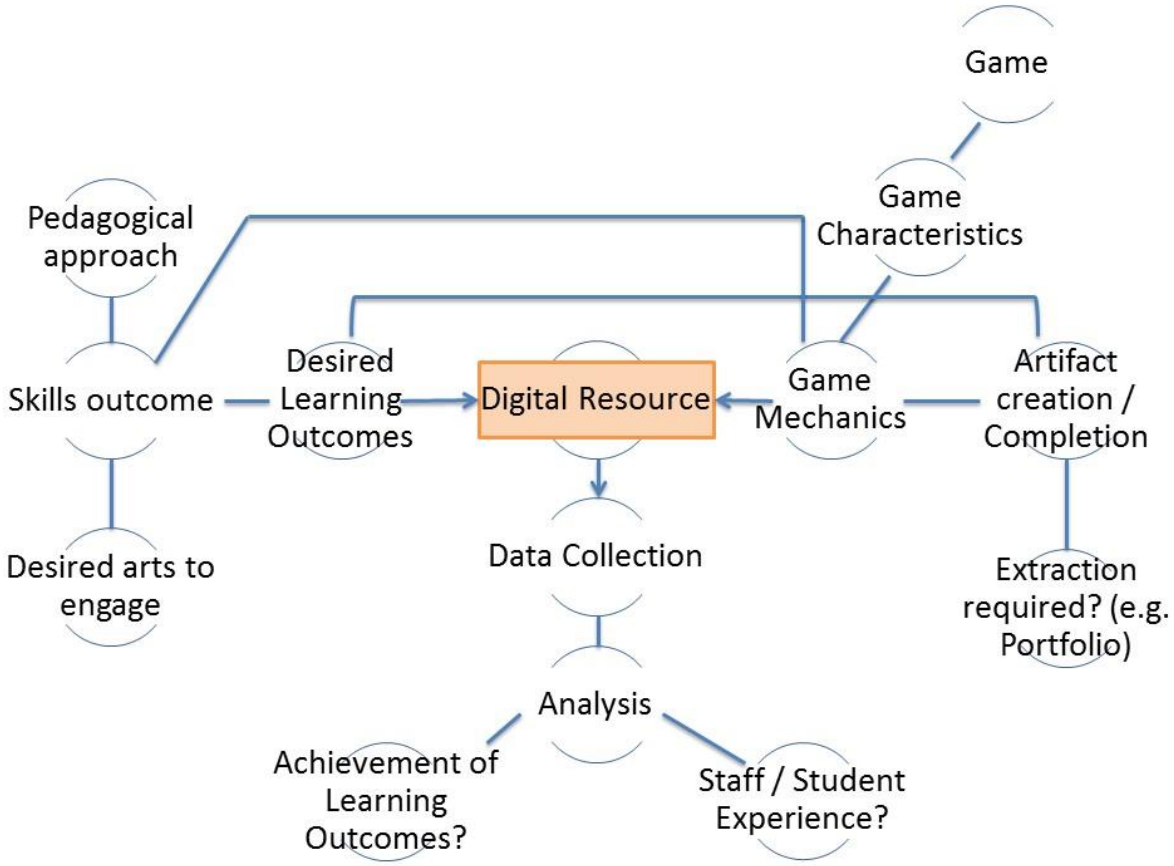

Figure 4-1: Conceptual framework for the application of games-based techniques to educational resources in the Creative Arts (Comley 2015).

The framework has been developed through consultation and feedback with learning technologists in higher education (HE), researchers from the games-based learning community, HE Creative Arts academics and researchers as well as pedagogic advisors in an HE Creative Arts setting. Each stage was identified through careful observation and discussion of the teaching and assessment process, alongside the essential considerations when developing a games-based activity and the priorities for underpinning empirical research. The framework provides the foundations for the development of experimental activities that can be used to assess the benefits of games-based techniques within collaborative learning in the Creative Arts. It is therefore the basis for the research that underpins this thesis. The use of this framework as guide, enforces the consideration of all aspects that are vital to the implementation, success and documentation of games-based activities in the Creative Arts.

4.1 Skills development and learning outcomes

The first step in creating a successful resource is to identify what learning outcomes (for example, skills and knowledge) need to be achieved. The information needed to make that decision comes from a variety of sources. Pedagogic variables such as how a module is delivered, the module outline and outcomes document and QAA benchmarks all have an impact on the decision-making process. Subject specific considerations will also guide some of the activities that participants could undertake, for example whether an element of photography or dance is included would depend on the subject area students are engaged with.

Increasingly higher education courses are using a blended model of learning. Blended learning is a term used to describe how traditional classroom delivery, technology-enabled activities and independent study can be combined together to form a coherent curriculum. The term blended learning was first used around the year 2000 and has been rapidly adoption since. Within published literature there is no agreed single definition of blended learning. One way is to define it as a mix of traditional methods of teaching, such as face-to-face and on-line teaching. Another definition is slightly more open and focuses more on learners' experience, 'a thoughtful fusion of face-to-face and online experiences' (Garrison and Vaughan 2008). This latter definition helps to shift focus away from the technology as a driver for change to one where there has been careful consideration of how each element of the delivered curriculum has been planned. From an educational technology instructional design perspective, the benefits of this approach to blended learning allows course material to be broken into 'chunks'. Here one can deconstruct a subject or concept into its individual learning objectives and then match these to an appropriate method of delivery, which may (or may not) involve technology. In the case of this study, the appropriate vehicle was Bluetooth Beacons as it enabled a locative activity to be developed that could then be undertaken by a group of students collaboratively. The beacons were not static and could be relocated as needed, and reprogrammed for other purposes, providing additional justification for their purchase. In another situation however, this approach may be not be the best solution and another technology, such as polling

software, may be more useful. The technology used must be chosen to suit the activity and its intended learning outcome.

It may be helpful at the design stage to refer to digital 'verbs' that can support Bloom's revised taxonomy, as seen in Table 4-1. This is based on the premise that before we create, we go through the stages of having remembered, understood, applied, analysed, and evaluated. Some view Bloom's Taxonomy 'as a roadmap to the traditional book-learning approach, or an instructionist view of education' (Cao 2009). This study's approach is better aligned with the constructionist approach to education, however, Churches' (2008) revised version in particular can provide inspiration and a reminder of 'digital verbs' (in other words the actions taken in an interaction) that can be used when formulating learning outcomes in a digital games-based learning context.

Bloom's Revised Taxonomy	Digital verbs
Creating	animating, blogging, filming, designing, podcasting, remixing, role playing, screen-casting, simulating, vlogging, wiki creation
Evaluating	Commenting, moderating, posting , rating, reviewing, scoring, testing
Analysing	Attributing, categorizing, linking, mind mapping, reverse engineering
Applying	Computing, hacking, playing, running, sharing, uploading
Understanding	Boolean searches, commenting, sharing, subscribing, tagging, tweeting
Remembering	Bookmarking, favouriting, googling, liking, networking, searching

Table 4-1: Digital verbs to support Bloom's revised taxonomy (Simplified version based on Churches' 2008).

Using this revised Bloom's taxonomy as a guide will result in activities that support students through all 'orders of thinking', promoting an active learning style as opposed to students taking on a more passive form. Instigating an active mode of learning and working through these orders of thinking is essential in ensuring students start to construct their own knowledge and start to actively operate in a

social learning context. These characteristics are vital if we want students to collaboratively learn, as outlined and discussed within Chapter 2 (p.38).

The foundations of an effective games-based digital activity are built on appropriately identified learning outcomes. Many failed or ineffective gamification attempts are due to a mismatch between the activity students are asked to do and the learning outcomes required by their particular module or course. In the case of a mis-match, the activity loses relevance to student learning and, whilst it may be an enjoyable intervention, it doesn't contribute to the intended learning experience. Overall, it is important to keep in mind that it is not about how to use the most exciting or appealing tools and technologies, rather the crucial point is that these are used to facilitate intended learning. As with any learning activity it is essential to identify the intended learning outcomes and select the most appropriate tools or technologies that help deliver these.

4.2 Game mechanics, characteristics and type

This chapter goes on to consider the game types and mechanics that can be seen from the observations and analysis of video games. However, it is worth considering the mechanics at play with non-digital game also. A non-digital games-based activity that is increasingly being implemented in an educational context is that of escape rooms or more often a portable version on a smaller scale such as table top 'mystery boxes'. These may include multiple containers locked with padlocks or combination locks. Often a sequence of logic puzzles, a physical jig-saw or hidden object puzzles and maths / code-breaking puzzles are presented to teams who have to solve them in order to open the final box. These challenges are usually designed in such a way to promote teamwork, communication, critical thinking. Physical artefacts can be used alongside digital activities, using multiple tools and technologies can be an extremely effective method; taking a blended approach as has been recognised as being beneficial in general teaching practice. Using a blended approach also allows for a wider scope in the types of game-play and puzzles that can be created. It is advisable to begin with small interventions, as

opposed to wholesale change, and ensuring there is confidence in each area of the design before bringing an entire escape room or table top mystery box scenario together.

4.2.1 Game type

When considering developing a games-based activity many will automatically start thinking about particular computer games, perhaps wanting to draw inspiration from their own or their student's positive experiences playing it. To begin to understand the engaging elements of a particular game it is important to understand its type. Identifying the type or genre of a game can provide a good starting point for picking apart what makes the game engaging and the implementation of that knowledge may have a beneficial impact on learning. As with other media, such as film or radio, many different genres exist. The increased popularity and reach of games, alongside the growing diversification of digital games, has resulted in a market for games where many genres are embraced outside of the traditional stereotypes of first person shooters (FPS), Sports or War games. As players have grown up, there has been a demand for more 'mature' content in terms of breadth and depth of game genres. Games such as *Life is Strange* (2015, Dontnod Entertainment), *Portal 2* (2011, Valve), *This War of Mine* (2015, 11 bit Studios), *Papers Please* (2013, Lucas Pope/3909) work on multiple levels, combining emotional narrative, problem solving, alongside references to the current political environment.

Whilst there is no standard classification system, a generally accepted taxonomy has emerged that is used when identifying game genres. Ted Stahl's (2005) example is a good representation of this. Over-arching categories including role-playing games, puzzle game, simulation and sports games, amongst others, are frequently used with more specific terms such as point & click, first person shooter (FPS) or massively multi-player online role play game (MMORPG) used for more detailed description. Often games can be seen to straddle two or more of these genres and at times there may be disagreement as to where a game sits in this evolving lexicon, *Journey* (2012, Thatgamecompany) being a recent example. There is also debate about genre in games as the terms are far from consistent: game genre

nomenclatures are sometimes coined around the type of activities undertaken, but equally may be regarded in terms of themes. Game Studies writers have often found that inconsistencies in the ways that genres become understood demonstrates the different stakes that marketeers and players have in games.

Different genres of games will often draw on different sets of skills. Wiklund (2006) conducted a study using commercial off-the-shelf games looking at the differing impact playing Massively Multiplayer Online Role-playing games (MMORPG) compared to First-person Shooters (FPS) on student's learning outcomes. In FPS games players navigate the environment from a first-person perspective, games are often fast paced and require quick reflexes. In MMORPGs, players are able to enter an online environment with numerous other players and are often required to complete quests or work together to achieve objectives. Wiklund focused on correlating the grades students received in English with their preference to playing FPS style games or MMORPGs. His results revealed that those students who had a preference for playing MMORPG's received a higher grade in English over the year. One of the possible reasons for this outcome that Wiklund (2006; 6) identified was that 'those students are receiving more training in, and exposure to, the English language, and as a consequence are both more experienced in, and possibly also motivated to study'. Although it should be considered that it may be the other way around; that those studying literature are more likely to play role playing games (RPGs)? Aside from Wiklund's study, MMORPG's have frequently been credited with improving English language skills as well as broader skills such as communication and collaboration. Other studies (Wu, Richards & Shaw 2014; McCrea 2012; Bryant 2006) having looked at the use of MMORPGs have drawn similar conclusions demonstrating that this particular genre of game can be used effectively to impact specific learning outcomes. Research into the influence of game genre (and therefore game form) on the design of educational games has also considered how different game genres may benefit specific learning styles (Rapeepisarn et al. 2008). Chuang et al. (2005) claimed cause-and-effect games tended to encourage means-end analysis strategy, whereas adventure games encouraged inferential and proactive thinking.

The data from Wiklund, Rapeepisarn & Chuang demonstrates the importance of considering how the genre and form of a game can influence a games-based learning activity. Entire genres of games are often defined by the mechanics they share. Even if the activity in mind is not explicitly following a particular genre, inspiration and direction for the types of formal mechanics that might be included in the activity can be gained by considering genre.

4.2.2 Game characteristics

Considering the formal characteristics of the activity early in the design process will help to achieve an engaging and game-like experience. Including this element into the design process can help to set the activity apart from the 'bad' examples of gamification that we see, where achievement points, badges or 'level ups' have been added flippantly in order to 'gamify' a resource or system. This latter approach is lazy design and does not acknowledge the formal characteristics in play that differentiate between an experience that is game-like and one that is not game-like. Focusing on formal game characteristics offer us the ability to focus on the player experience, enabling and deploying a basic level of game design to be adopted by non-specialists. Whitton's ten game characteristics (2010), as introduced in the contextual review, are a clear resource that can be referred to in the design process. Whitton used these characteristics to define how game-like an activity is based on how many of these characteristics it embodies. This research has considered the characteristics identified by Whitton in its design stage, along with the addition of the participant characteristics, the inclusion of Suit's lusory attitude and the principle of voluntary participation.

Whitton's identified characteristics (competition, challenge, exploration, fantasy, goals, interaction, outcomes, people, rules and safety) proves to be a useful starting point for inspiration for educators when designing a games-based activity. Making a conscious decision to build these characteristics into a design can make a difference between including some badges to make an activity *appear* game-like, or, instead, designing an engaging educationally directed games-based activity. In

addition, there are some important characteristics that can be focused on to engage a particular groups of learners. For example, the inclusion of competition may be useful when trying to motivate teams to work together, or, ensuring that there is an emphasis on fantasy when wanting to engage creative writing students in composing a narrative. Similarly, certain characteristics are more prominent in particular types of games. Of specific interest to this study is the use of characteristics that lend themselves to games that are collaborative in nature. By emphasising and combining the elements of interaction between people, it becomes possible to ensure that the requirements for collaboration are built into the very foundations of the game.

This mindful design process allows for specific themes to be incorporated within the games-based activity rather than being 'bolted on' at a later point. As a result, the results will be more robust and justifiable as a concept. This will then aid in engaging participants, as well as with the later analysis of how successfully the game has achieved its purpose.

4.2.3 Game mechanics

There are many formal game mechanics that could be incorporated into a learning activity, however not all will lend themselves to the educational designers' desired outcomes. Any game mechanic that is used needs to be chosen with an understanding of how it can be implemented effectively and the impact it may have on learning. This is best done through research into the origins of the mechanic, looking at the types of games it can be found in and the characteristics of these games. For example, games which implement a countdown mechanic, such as *Super Mario World* (1990, Nintendo), use this formal device to introduce for the player a sense of pressure by putting a time limit on the required action. This serves to focus the attention of the player on the objective whilst working under a constraint. This type of mechanic may be desirable for use within a learning activity, for example, a time sensitive group work activity. In this example the timer is not included to make the activity 'feel' more like a game, rather imposing a time limit on the activity becomes beneficial to the task and learning outcome desired.

Resource management is a formal mechanic that is implemented in many different types of games. This mechanic results in players having to moderate their behaviour and assess their decision-making based on the resources available to their character. A typical example of this is *Legend of Zelda: Breath of the Wild* (2017, Nintendo). In this game the player's character, Link, has a 'Stamina gauge'. This gauge is displayed as a small wheel on screen and represents the amount of 'Stamina' the character has for activities such as running, climbing and swimming. Although this Stamina bar will recharge, players need to be mindful to not deplete the bar entirely to avoid being left in a vulnerable, exhausted state whilst waiting for their Stamina to replenish. This mechanic can be translated into a group-based activity by providing participants with a finite set of materials or resources to complete a task (as in the Zelda example, it may be that these resources can replenish over time). Now participants need to agree the best course of action to complete the task with success or failure based upon how they manage those resources. This decision requires participants to communicate, negotiate, plan and allows for the group to fail and perhaps try again (if the game permits).

By identifying the behaviours that specific mechanics can affect, a more informed decision can be made and justified for their inclusion within the activity.

The formal game mechanics outlined below are presented alongside a justification as to how they may affect the development of the specific skills required for collaboration in the arts (i.e. improvisation, visualisation and conceptualisation). Just as some mechanics will be more suited to particular learning outcomes than others, so some will be more suited to instigating or enhancing creative collaborative activities than others. Suitable mechanics include, but are not limited to, those shown in Table 4-2 below alongside suggestions as to how these might be incorporated into a group activity.

As outlined in the Contextual Review (p.24), this study is partially guided by Schell's (2008) definition of game mechanics, which is sub-divided into the categories of Space; Objects, Attributes, and States; Actions; Rules; Skills; Chance. The use of these categories as guiding principles when thinking about games mechanics in Creative Arts games-based activities is very appropriate. When Schell outlined these

categories, he emphasised the difficulties of producing a defined taxonomy. Schell acknowledged that part of the purpose of formal game mechanics was to influence and impact on the 'mental model' or experience of a player. Since this involves affecting both the conscious and sub-conscious minds, a clear taxonomy to account for these interactions is problematic and open to debate. We can see similar difficulties when asking multiple people to make value-based judgements on creative practice. Since the task is so subjective, it is useful to have broad categories rather than a strict taxonomy to guide development, partly so that the focus can be on creating good connections between the action and the effect in the game design rather than on the academic process of developing a taxonomy. As Schell noted, that is not to say there is no a place for philosophising around game mechanic taxonomies, it is just that it is not as useful to detour into this when designing games. Schell's categories that were used for this study are included in the list and were useful benchmarks for considering and predicting how the mechanic was going to impact on participants.

Compiling a similar list can be a useful exercise to undertake before attempting to put an activity design into practice. The mechanics outlined below were of particular value to this study. They provided a justification as to why a particular mechanics had been selected for use and helped to give confidence that the choices were sufficiently underpinned with the learning outcomes in mind.

Mechanic	Schell's category	Description of relevance to collaborative, creative work
Time dependence / countdown mechanic	Mechanic 1, 5.	Participants must fulfil certain objective/s within a specific timeframe. This can be designed so that it is impractical or impossible for a single individual to meet a deadline, therefore requiring effective group work in order to complete the task successfully. This can be easily implemented in activities that require students to put together a presentation or portfolio with which to pitch to an audience or panel.
Appointment mechanic	Mechanic 1, 3, 4.	This mechanic requires participants to carry out a certain action or be in a particular place at a designated time. It can be used for collaborative work by requiring a group to coordinate themselves to meet multiple '.appointments or all make the same appointment.
Resource management	Mechanic 2, 5.	This may involve a group of participants managing a finite set of resources in order to complete a task. This could be materials, time or people. It can be set-up to require collaboration and in a creative arts context could encourage inter-disciplinary or trans-disciplinary working through restriction of the materials or tools available to use.
Combo mechanic	Mechanic 5.	The idea that combining certain actions in a certain order provides the participants with a greater advantage than the same actions would out of sequence. A useful tool that can be used to aid inter-disciplinary collaboration and encourage students to consider how different elements of a collaboration come together.
Player roles / party mechanic	Mechanic 4, 6.	Providing each participant with a specific role ensures an awareness of individual accountability as well as a sense of shared achievement once the task has been completed. Tasks can be formatted in such a way that participants are required to share knowledge specific to their role with others.

Mechanic	Schell's category	Description of relevance to collaborative, creative work
Cascading events	Mechanic 1, 3.	Where one event triggers another, which, in turn, triggers the next and so on. Can be used to instigate forward planning within a group and encourage an awareness of cause and effect.
Narrative control / storytelling mechanics	Mechanic 1, 6.	The actions of participants affect the narrative or outcome of the task. This can be used in numerous ways: the group can be made aware that this mechanic is in play, resulting in each action being more considered, or the mechanic may be revealed at the end when groups realise their outcomes have differed depending on how they have carried out the task. For example, in the context of a creative writing task or drama exercise, this can be used to demonstrate the impact of a student's contribution on the overall narrative created by the group.

Table 4-2: Examples of game mechanics suited to the Creative Arts

4.3 Artefact creation

This framework is designed to allow for the flexibility that is essential for creative projects to flourish. Each subject has unique aspects and differences that need to be accounted for when designing resources, games-based or otherwise. Within the Creative Arts, the work created as part of a task may contribute towards the development of personal practice, fulfil a need to be referenced to in future work, to be included in a portfolio, or become the beginnings of a longer project. Current examples of games-based learning activities offer no options for the contributions of participants to be extracted or documented by the participants themselves. Considering these possibilities during the design stage allows for this functionality to be included, as well as acknowledging the diverse ways of working that must be allowed for in interdisciplinary arts collaboration. It is important to note that while there will be an intended goal communicated to students and presented in an activity or module outline, frequently student-led collaboration can have

unforeseen consequences that may result in both positive and negative outcomes that are not accounted for at the design stage. Contingency plans to support students in these situations are invaluable.

When considering options for the curation and potential extraction of student work, it can be difficult to find an appropriate tool that could be included within the functionality of the games-based activity. An added complication can be whether such tools are GDPR compliant. Resources that are within the institutional domain, such as e-Portfolio tools (Mahara, PebblePad), may be suitable but not always available. Office365 or Google apps could offer a great space for collaboration but may not be an appropriate place for storage of content that a learner may want to access post-graduation. It is often necessary to look outside of the institutional domain at external tools such as the collaborative portfolio app Dextra, using shared boards in Pinterest, Mural or other collaborative white-boarding tools. Using a tool outside of the game itself also provides the opportunity for ongoing collaboration should students wish to build upon what has been created continuing to create outside of the context of the game. Building a digital portfolio can often function as both a means to reflect on a learning journey as well as a self-promotional tool for employment. Any pieces that arts students work on within their degree should be accessible for these purposes.

Despite having a strong argument for the ability to extract content created as part of a games-based activity, there are often barriers in place that need to be considered.

We are familiar with the ability for players to create content within or throughout the process of playing a game. Games including *Minecraft* (2009, Mojang / Markus Persson/ 4J Studios/ Other Ocean Interactive, Xbox Game Studios), *Little Big Planet* (2008, Media Molecule / Tarsier / Sumo, Sony) or *Fortnite* (Epic / People Can Fly), allow for artistic design and self-expression. *Elegy for a Dead World* (2013, Dejobaan / Popcannibal), for example, is a game where the player creates the narrative, and it actively encourages creative writing. However, the focus of these games is very much on the creation of content for use within the specific game environment and rarely is there acknowledgement or process for the extraction of

player created artefacts. In *Elegy for a Dead World* players can take screenshots of their work and choose to have these printed into a physical book which includes the games' artwork (as is also the case with the app Instagram). This is progress in terms of output from the game of player-created content, it doesn't however encourage any further work or collaboration going forwards.

Usually when work is created by an individual student in an Arts University context, they will own the Intellectual Property (IP) to that work. However, once collaboration happens, this can impact who 'owns' the work and it is something that is worth considering if substantial group work or collaboration is undertaken and encouraged. This is of particular importance in the case where content is produced that that students want to develop further on graduation. For example, if students are collaborating with staff or a research group then potentially the IP will be held by the University.

One of the fundamental aims of this research was to enable and support interdisciplinary collaboration. This type of collaboration has its own difficulties when it comes to students being able to extract and preserve works made. Often a mixed methods approach has been taken within the collaboration and no longer is it, for example, 'a drawing' that needs to be reclaimed, but perhaps, 'a drawing with an audio element'. Content may be therefore a combination of digital and non-digital assets. Encouraging students to consider how this may be collated into one piece of work or viewed as one piece across different platforms prompts students to consider other elements of collaboration and the challenges it can throw up. It is also useful to direct students to consider the longevity of their work, how sustainable their methods are for collaborative working and how the tools they choose can affect the opportunities that work presents at a later date. The knowledge gained from an investigation into their options will not only benefit the sustainability of their work in an academic context, being able to work on something and make revisions over the entire course duration, but also provide insight into the tools that are used in industry and by creative professionals.

4.4 Data collection

Gathering data related to how well learning outcomes have been met has been a persistent challenge for educational researchers. Fitzpatrick, Sanders and Worthen (2004) identified almost 60 different models used between 1960 and 1990 alone in projects attempting to measure achievement of learning outcomes. Many of those models were not based around any theoretical framework on which to explain how its logic was predicated. In games-based learning research a contributing factor towards this lack of evidence is a misplaced focus on the perceived novelty of using games-based learning compared to traditional 'chalk and board' instruction. The focus on student satisfaction obscures the fact that, as with traditional methods of teaching, it is only the success in meeting learning outcomes that determines whether games-based learning is effective in education. Of course, any study seeking to demonstrate the effectiveness of games-based learning will want to evaluate both staff and student experiences and engagement but they should do this as well as monitoring achievement of learning outcomes, all of which should be recognized and presented as distinct from each other.

There are many methods of data collection that can be used. This research project has utilised several including semi-structured interviews and observation, however of particular value was the method of Personal Meaning Maps. The principles and general values of Personal Meaning Maps were explored in the Chapter Three (p.64). This method has been selected for data collection because of its suitability for the difficult task of collating the evolution in thinking from an individual on a subject area with largely undefined boundaries. The nature of what collaboration means and what it is may differ from one person to another therefore providing a method of evaluation that allows for a personalised response ensures increased understanding and depth of knowledge will be recorded.

This researcher found the medium of Personal Meaning Maps (PMM) to be an unthreatening and relatively unobtrusive method to track participant's initial thoughts and feedbacks. Students were familiar with the 'brain storming' like structure of the Personal Meaning Map and were grateful that they did not have to construct statements or paragraphs of text on a concept that they were not familiar

with writing about. The Personal Meaning Map was a way in which they could be confident their contributions were understood within the context of collaboration, because they quite literally connected their thoughts to the central theme on paper.

The resulting maps allowed expression for the learner's associational thinking around the idea of conducting collaboration, allowing the individual to build upon their concepts with no 'right or wrong' answers, expectations or preconceptions. The entire process provided an opportunity to demonstrate how the scaffolding of learning around the games-based activity resulted in a development in thinking, expanding the learner's understanding of the concept of collaboration. This method of recording and expression was particularly suited to the students taking part in this research as it allowed for non-written based additions or elaboration, a welcome addition for some. Regardless of the subject or context within which Personal Meaning Maps are used they are a very accessible choice. Maps can be created digitally or on paper. They can be dictated if needed and the basic principle can be explained to any age group and ability.

Additionally, the use of Personal Meaning Maps allowed this researcher to distance herself and avoid imposing her own conceptions of collaborative working. Working within education, and specifically having worked on research projects focused on team-based learning, as well as the use of educational technology for collaboration, the researcher will have her own defined ideas of what collaborative means, entails and why it is useful. Avoiding communicating this to the participants was necessary in order to obtain un-objective or influenced data from the students.

Within this study the use of observation was an appropriate and valuable method. Capturing artistic practice and collaboration requires a multi-faceted approach, combining individual feedback, group feedback and in this case a photographic record of activity taking place. Using a photographic record enabled a visual catalogue of the skills and interactions that took place during the games-based activity. This included participants recording soundscapes, making sketches, taking photos themselves and having frequent discussions as to the best way to proceed or a contribution to the group work they were making.

The participants in the activity considered in this study were asked to create an artistic representation of their journey or map, using a combination of their specific practices. It was made clear that the map did not have to be a traditional cartographic map but more of a representation of both their physical and emotional journey throughout the game. As a result, the outcome of the game also acted as piece of data collection. Through the collaborative map there was potential to ascertain the input from different group members, their successes and possibly failures in solving the challenges around the route.

Using outcomes of the game itself and game data can also provide rich, detailed information regarding one aspect of the learner interaction with the game itself. Depending on the type of games-based activity created, the data may be able to demonstrate how effective the design was. Did participants frequently drop out at a particular point; was a specific puzzle too challenging? Such questions could point towards a number of potential issues that could then be explored further through more data collection (semi-structured interviews, feedback forms) and then analysis to determine the cause (asking questions such as, was it bad software design, was it a result of the learning not being effectively scaffolded within the game?). Game data can provide useful quantitative feedback that can be enriched and elaborated on with qualitative methods. In this study using a mixed methods approach strengthened the validity of the data collected, preventing assumptions being made on one strand of information.

4.5 Analysis

Identifying appropriate methods which assess impact on learning outcomes and assess effectiveness at the start of a study is good practice, as is using a triangulation of methods which helps to establish the validity of any findings. Alexander (1999) outlines fourteen methods that could be utilised, including a comparative study with control and treatment group, pre and post-tests, questionnaires concerning students' perceptions of learning outcomes and experts' reviews. It must be noted however that comparative modes of evaluation using

different groups of students can be hindered by individual differences in the characteristics of participants. It is impossible to control all variables when comparing traditional teaching methods with those utilising technological innovation; this has to be compensated for as much as possible.

As described in the Contextual Review (p.48) and Research Design (p.57) chapters, the Learning Mechanics-Game Mechanics (LM-GM) model has been used to evaluate the pedagogical effectiveness of game mechanics. The LM-GM model is valuable on several counts for implementing games-based learning into digital activities in the Arts. The model supports games-based learning designs that are rooted in different theoretical backgrounds, whether intructivist, constructivist or situationist, which enables a wide variety of pedagogical activities to be supported. Whilst this particular research project is rooted in a constructionist background, as discussed in the Contextual Review (Chapter Two, p.38), the wide range of art practices and ways in which they are taught means that this model can be of use in multiple contexts. As introduced in the Research Design (Chapter Three p.57), using the LM-GM model enables the creation of a map, highlighting the links between the mechanics and learning outcomes used within the game. This then becomes one of several tools used to evaluate the effectiveness of the game-based activity designed.

Personal Meaning Maps were used as a data collection tool within this study, the method used for their analysis is particularly suited to identifying impact on the development of participant understanding or knowledge. Through a comparison between the before and after contributions to the Personal Meaning Map we can analyse a participant's 'Mastery', whether their understanding of the subject matter is novice-like, proficient or highly detailed. This level of mastery is arrived at by a thorough analysis of the connections and quality of the ideas and thoughts on the Personal Meaning Map, considering four semi-independent dimensions: Extent; Breadth; Depth and Mastery. It is difficult to demonstrate impact on learning, yet this method enables a creative input and a clear method to analysis progress using a quantitative method of scoring. This process is considered in more detail further on in Chapter Seven (p.166). As well as the benefits highlighted in terms of the data collection technique, the ability of Personal Meaning Maps to allow for such in

depth analysis of learner knowledge that has been captured in a quick and simple way is incredibly valuable.

Keeping a record of observations and conversations during the games-based activity also provide valuable material for analysis. Particularly in a time-sensitive, creative collaboration, actions are taken that can be captured, for example by camera, and can then be considered in more detail at a later stage. Undertaken later such analysis may provide further insight into how inclusive the collaboration was or perhaps whether a natural leader was emerging.

Concerns regarding the use of appropriate methods for evaluation and measuring outcomes are the same in the Creative Arts or STEM subjects, Alexander's techniques are equally suitable for both. There is often a misplaced perception that Arts subjects are problematic to assess (Orr 2010), this perception has contributed to the weak background of empirical study around impact on learning outcomes in this area. Through the use of methodologies such as those outlined by Alexander, or tools such as Personal Meaning Maps, assessment practices in Creative Arts education research can be strengthened. The conceptual framework presented above encourages an educational designer to consider the tools that will be used not only for the data collection but also for the analysis ahead of starting the activity design. This strengthens the design to ensure that ascertaining impact on learning is a consideration throughout the entire process.

If the decision to use games-based techniques is taken, a robust empirical approach and sound implementation is needed. Regardless of how small or large a study is, by using the conceptual framework presented here to make clear, concise and justifiable decisions, valid data and appropriate resources will be produced with the required evidence to support findings. Consistent use of this framework will provide transparency to the process of integrating games-based techniques into resources. It not only provides prompts and discussion points but can also offer opportunity for both staff and students to contribute to the development and use of innovative methods in games-based learning. These studies can then provide the empirical evidence that we currently lack to better inform educational technology policy,

support sustainable teaching practice and enable future activities incorporating games-based techniques.

Using this framework to ensure a mindful approach to design can assist not only with ensuring game mechanics, characteristics and type are contributing to the fulfilment of learning outcomes, but also that they are specifically supporting the scaffolding of learning that will take place throughout the game, and that this is *why* the design decisions are appropriate for the learning outcomes.

Many of the frameworks that have been developed to support the creation of games for learning are still quite daunting for those with no experience of games design or perhaps educational technology. The resource presented here is intentionally designed to be simple to follow and clear to understand. Each stage is backed up with sound pedagogical and technical evidence with signposting for those wanting to delve into any particular stage in more detail.

Finally, and most importantly, the use of this framework within the Creative Arts addresses the concerns and perceived barriers that exist regarding the use of digital games-based techniques in Creative and Arts education. Its use will result in case studies that can explicitly demonstrate how manual creative practice can be combined with digital games-based activities that are beneficial rather than detrimental to the development of creative collaborative practice.

5 Design of experimental prototype

This chapter presents the design process and considerations involved in the creation of an experimental prototype that will demonstrate the potential use of games-based techniques to support interdisciplinary collaborative learning. Before this design was conceived practitioners working in higher education Creative Arts institutions around the UK were interviewed in order to draw out any themes, expectations or perceptions as to how games-based activities may be usefully implemented within teaching practice. This chapter considers the analysis and interpretation of that data before going on to demonstrate how the conceptual framework laid out in the previous chapter has guided the design process. The rationale behind the selection of learning outcomes and game mechanics chosen for this experimental prototype are discussed followed by an overview of the hardware chosen. The chapter concludes by presenting a visual representation of the game mechanic and learning outcomes relationships using a Learning Mechanics-Game Mechanics (LM-GM) map. Throughout, the design of the prototype is firmly positioned within the specific context of higher education Creative Arts addressing the challenges of collaborative interdisciplinary authorship that have been identified both in the contextual review and from the interviews with staff as discussed below.

5.1 Semi structured interviews to accompany desk-based study

This researcher's desk-based study, during the contextual review, found there was little evidence of games-based learning being implemented within teaching practice in Creative Arts higher education institutions (HEIs). Therefore, the decision was made to interview a small sample of practitioners working in a variety of Creative Arts HEIs based in the UK to investigate if the findings reflected those of the literature. Additionally, the interviews would offer insight into the appetite and perceptions held relating to games-based learning and its inclusion within teaching practice. Interviewees would also be questioned regarding the skills they felt were necessary for effective collaboration and their experiences of supporting

collaboration in the Creative Arts particularly how this translated into learning experiences for their students.

A call was put out via a variety of networks including social media, using relevant hashtags, special interest group networks and existing academic networks at Falmouth University. As a result, six interviews with interviewees based at six different Creative Arts HEIs were conducted. These took place via Skype / phone calls or in person, depending on where in the UK the interviewee was based. The interviews were semi-structured since the main motivation was to draw out any experiences, knowledge, expectations and perceptions around any aspect of games-based learning in higher education Creative Arts. Interviewees were provided with an information sheet (see Appendix two) and a set of questions to consider in advance (see Appendix three). Each interview lasted between 30 and 60 minutes.

All interviews were recorded and transcribed. Interviews were transcribed to allow the researcher to analyse the content in detail rather than relying on note taking and memory. Transcriptions were formatted to allow for the use of NiVivo (Computer Assisted Qualitative Data Analysis) to analyse the data. This enabled an iterative approach to be taken with the coding process, systematically translating the data into codes, then categories and finally themes, as recommended by Johnny Saldana in *The Coding manual for Qualitative researchers* (2013). This process began with a pre-coding phase where the researcher re-familiarised herself with the text, highlighting significant quotes and annotating where needed.

To avoid researcher bias that can be present when solo-coding, and to improve clarity, interpretations and codes were discussed with colleagues with relevant experience, for example members of the academic development team at the University of Exeter were consulted when this researcher was clarifying emerging code and categories related to pedagogy.

The first cycle of coding identified thirty codes this was however refined and revisited with a second cycle of coding which reduced the codes to twenty, capturing the essence of the text. As a second cycle of coding progressed it became

apparent that the interview content, both from the structured questions and from the additional content led by interviewees, covered four themes:

- Collaboration
- Game-based learning
- Support
- Teaching practice

Theme 1: Collaboration

There was a unified attitude towards the idea of collaboration which emerged into two distinct categories. Each interviewee suggested that the ability to collaborate was essential for a Creative Arts graduate. Ensuring undergraduates are able to partake in collaboration effectively was seen as a,

> ‘pretty fundamental underpinning of what we're trying to achieve’ (Interviewee 2)

There were multiple references to the importance of collaboration and how that is supported. The most striking concept was its importance in the future to students and it became clear that these comments could all be categorised under the term ‘Employability’, for example that it would be a pre-requisite for working in industry. That it is a requirement to…

> ‘really genuinely collaborate with a group of people trying to problem solve together. Because it meant that if you didn't it-- the film didn't get made’. (Interviewee 4)

And to the extent that a student’s ability to collaborate could impact employment opportunities.

> ‘If you can't collaborate, you won't get a job’ (Interviewee 4)

> ‘Collaboration is a necessity I would think for anybody today’ (Interviewee 2)

Yet despite acknowledging the importance of developing this ability all interviewees, bar one, when asked if they or their institution support

interdisciplinary collaborative working, talked about the lack of formal opportunities for this within their Universities,

> ‘It’s an institutional issue. It's about how departments speak to each other and where the responsibility ultimately’ (Interviewee 4).

> ‘not really, even around building things together’ (interviewee 1).

And, in addition, how difficult it can be to get buy-in from students to voluntarily collaborate with others (an issue when we consider the comments on the importance of developing this ability for their future employment opportunities).

> ‘It tends to be trickier because, um, you end up with, um, one group of students with one agenda, and another group of students with a very different agenda’ (Interviewee 3).

Each participant was able to offer suggestions as to the skills required for collaboration in the arts. Whilst many of the skills put forward are the same or like those generally accepted as collaborative working skills across all subject areas, there was a general acknowledgement that it may be harder in a sense to apply these skills when sharing artistic practice:

> ‘there are those who want to collaborate, and there are those who actually are lone workers, and they don't like it, and they don't actually get it. Um, and they don't really like being put into that situation’ (interviewee 4).

Many students do not seem to appreciate the importance of developing these skills in order to progress in their chosen subject area. In order to frame the skills required for collaboration in a more relevant way, I have categorised under the following four headings that encapsulate the process of collaboration.

Conceptualisation: The ability to take one’s own ideas and inspiration, and pitch this to others in an appropriate way.

Visualisation: The ability to constructively listen to and interpret someone else’s artistic proposal.

Improvisation: Being able to respond, without preparation, in order to overcome unforeseen or challenging situations.

Organisation: Effectiveness in maintaining the more administrative side of group work, including time management and digital skills

The table below shows which of these overarching categories the skills outlined in the transcripts come under.

Skills identified by interviewees	**Higher level categories the skills have been assigned to.**			
	Conceptualisation	Improvisation	Organisation	Visualisation
Communication	x	x	x	x
Critique – give/take	x			x
Digital Skills	x		x	
Improvisation		x		
Intellectually generous	x	x		
Negotiation		x		
Time management	x	x	x	x
Understanding group strengths and weaknesses	x	x		x

Table 5-1: Skills identified in interviews required for collaborative working.

These four overarching categories will be incorporated into the game design to ensure the skills for collaboration are integral to the activity, rather than superficial.

Theme 2: Games-based learning

None of the interviewees were aware of any games-based learning taking place with a Creative Arts HEI. There was an awareness that a playful and games-based approach may be happening outside of higher education in the Creative Arts sector but that it hadn't been incorporated into teaching.

Whilst there was a positive response to the idea of using games for learning, when it came to the interviewee's personal practice there was a lot of resistance that was verbalised. This was partly due to a perceived resistance from the University, evidenced as follows:

> 'Not serious enough for higher education use…there is resistance to that because it looks childish' (Interviewee 3).
>
> '…university's still fairly set on assessment methods' (Interviewee 5).
>
> '…resistance comes more from the-the investment of time…the costs to getting things set up' (Interviewee 6).

There was also personal resistance to incorporating this option into their practice:

> I think gamification is a- is a dead end, personally (Interviewee 1).
>
> I don't have an objection to games per se. It's just not, for me it's not the way I work (Interviewee 2).
>
> I would feel that-that I would be let down technologically at the last minute (Interviewee 4).

Most points here seem to stem from a lack of confidence, knowledge or support in how games-based techniques could be implemented in the subject area. Interviewee 1, who felt gamification is a dead end, works on a games development course and had been positive about games for learning in general, however this interviewee only considered the stereotypical 'gamification' methods such as badges and levelling-up when thinking about incorporating games-based techniques into the curriculum. As discussed in the Contextual Review (Chapter Two, p.15) the term 'gamification' has at times been mis-used and misrepresented and there is a perception that gamification is the 'chocolate covered broccoli effect', making a bad thing good.

In light of the comments highlighted from these interview, examples of good practice would be invaluable for demonstrating the effectiveness and possibilities of implementing a playful or games-based activity into curriculum. When promoting games-based pedagogies it will be important to dispel ideas around 'bad'

gamification, that games-based activities involve complicated technology or that games are a 'one size fits all'. For both educators and institutions to have the confidence to include games-based techniques in their creative arts education there needs to be both theoretical guidance and practical evidence to be drawn upon.

Theme 3: Resources

Such theoretical and practical guidance may come in many different forms in addition there would be need to the option to access resources and support that would aid the implementation of interdisciplinary collaboration or games-based learning. This was a theme that can be broken down into two categories, practical support and theoretical framework.

In addition to the institutional resistance, or at the least lack of formal opportunity, for both interdisciplinary collaborative working and games-based learning, the perceived lack of practical or educational technology support was also raised by some of the participants:

> 'You know, it's not the way things are set up at the moment and not conducive to feeling confident that that could happen in a way that would be smooth' (Interviewee 4).

> 'There's a willingness, but there's disconnect… It's very much, it is departmentalized… so there are some hoops and stuff you have to jump through' (Interviewee 1).

As well as practical support, the desire to reach for a theoretical foundation on which to inform the manner in which games-based techniques may be incorporated into Creative Arts teaching practice was expressed in both vague and explicit terms.

> It's always useful to have something to-to look to (Interviewee 5).

> 'As long as that framework can support that kind of teaching … to have a kind of conceptual framework where you can actually have that, I think, yeah'. (Interviewee 1).

These sentiments are addressed by the objective laid out in the Introduction of this thesis, i.e. to create a conceptual framework with the intention of providing this type of support to academics as well as other stakeholders such as Educational Technology teams.

Theme 4: Teaching practice

Discussion often returned to the idea of how pedagogically sound incorporating games-based techniques into their personal teaching practice would be. Whilst most participants expressed a positive reaction to the idea in general as we have seen in Theme 2, there was resistance to inclusion within their own practice. Theme 4 covers the pedagogical elements of the discussion and includes the categories of Learning Outcomes, Interdisciplinary work and games-based learning in own practice.

As suggested in Theme 3 participants felt they lacked the theoretical knowledge to fully implement a games-based approach. How having this support would impact their teaching was expressed both in terms of pedagogic practice and overall confidence and enthusiasm.

> ‘if I could tie that more directly to some kind of specific learning outcome, as opposed to just in getting engaged … I think it would work really, really well’ (interviewee 1).

> ‘I'm excited- I would say that it's the occasional ad-hoc thing but nothing has been this formalized’ (Interviewee 2).

All participants aspired to a more interdisciplinary approach in their teaching practice, recognising its potential to enhance students’ personal practice as well as their future prospective (as expressed in Theme 1)

> ‘we really were trying to work against to get people to come out of their silos…so product designers can be- they can come work with ceramicists, or people can start their own business or work with one of our research groups’ (Interviewee 2).

> ‘I brought speakers in from the industry that give them the tools and the advice about how they can-- they can do that [*interdisciplinary working*]’ (Interviewee 4).
>
> ‘we have game jams… and that's not just between programmers and artists. We also bring people in from sound, and other kind of areas’ (Interviewee 1).

The themes articulated above are considered in the design of the prototype developed as part of this research. Each theme can be related to at least one of the aims and objectives of this research. The theory and methods outlined in earlier chapters are well placed to ensure the themes raised in these interviews can be given due consideration in the prototype design. This chapter now proceeds to demonstrate the practical application of the framework and supporting pedagogical theory to design a games-based activity.

5.2 Design criteria

Before attempting to design the games-based activity the design criteria needs to be defined. This will be unique for each situation. Within this study the intention was to create a games-based activity that students from a broad range of subjects could partake in. At the researcher’s institution subjects ranged from Creative Writing, Film and Fine Art to Games Design, Music and Photography. As such there was a desire to design something that students from any of these subjects could partake in. The purpose was to be an activity that would require participants to use and develop the skills required for collaborative working in an interdisciplinary context.

In this design a locative games-based activity was chosen in order to allow participants to engage with exploration and curiosity, making the most of the campus grounds, visiting areas they may not be familiar with and coming into contact with buildings and environments usually occupied by students from other disciplines. Additionally, by choosing a locative game it lent itself to the end

collaborative task which was to create a map of the group journey during the activity. As is generally desirable with many educational activities, there needs to be a low barrier to entry. The learner focus needed to be on the activity itself rather than getting to understand some new software or complex rules. In the case of this study's activity it was particularly important for participants to feel they could partake without any barriers to overcome; this activity would be a one-off exercise for each student and not something that would be revisited.

Learners will be from a diverse set of subject areas and have a variety of needs in terms of accessibility therefore a user focused approach needs to be taken to the design of the content. The activity should be designed to be accessible to the widest possible audience and the interface aims to be compliant with Web Content Accessibility Guidelines (WCAG) 2.0 in order to maximise learner participation. Consideration of accessibility will be included in the iterative process and any feedback from learners around inaccessible learning objectives, content or any other aspect will be responded to in the design.

Text-based content will be written in unambiguous language, avoiding jargon or figures of speech where possible. Audio-visual content will be used considerately, for example background music will only be used sparingly and if there is clear pedagogical justification. Alternative ('alt') text will be included with any images used within the activity as required for those using screen readers.

Fundamental to this study is the involvement of academics and learners in shaping the creation of a resource that will ultimately meet their needs and is usable within a higher education context. This desire has guided the design of this research in the selection of the Design-Based Research methodology and needs to be recognised within the design criteria to ensure that the ability to take an iterative approach in improving the activity is possible. A participatory approach ensures that the needs, motivations and expectations of all stakeholders can be considered, many of which the participants themselves may be unaware of prior to engaging with the feedback process. Often academic staff are expected to implement innovative instructional design or resources while not having be involved in the design therefore having no ownership over the content or invested interest in ensuring feedback can improve

design. This approach results in resources which are unsustainable at best and unfit for purpose at worst (Könings, Seidel and Van Merrienboer 2014).

Increasingly a participatory approach alongside integrating the perspectives of others into design is being recognised in higher education. Whilst this activity will not be a fully student-led design, with students controlling decision-making, participant feedback will influence further iterations of the activity. A participatory approach can be seen from the themes arising in the staff interviews feeding into the design process and later from the student feedback leading each iteration.

For this experimental prototype one of its primary remits is to test and put into practice the theoretical guidance as laid out in this thesis, including demonstrating use of the conceptual framework. The aims and objectives of this study are such that following the design and implementation of this activity, others will have confidence to use the tools provided to design and put into practice their own games-based activity. Therefore, each design stage, iteration process, and the subsequent evaluation requires documentation and transparency. This researcher would argue that this is necessary for all innovative interventions, in order to contribute to the body of empirical study which enables others to follow and further build upon the research.

The needs articulated above can be distilled into the following design criteria:

- Suitable for students from a range of Creative Arts subjects to participate in
- Allow for an outdoors environment and movement.
- Low barrier to entry
- Accessible
- Participatory design orientated
- Documented and transparent

These design criteria along with the guidance from the conceptual framework provide a set of heuristics for the development of the game-based learning activity.

5.3 Pedagogical design

The pedagogical approach taken in the design of this games-based activity is one of task-centred learning rather than a didactic instructional approach. The benefits of an active learning experience have been clearly demonstrated as discussed in the Contextual Review (Chapter Two, p.38) and as seen with the widespread acceptance of Bloom's taxonomy, therefore the researcher sought to exclude passive learning and ensure all learning took place in an active, social context. Influenced by the models presented in the HEA PALATINE project (Alix, Dobson and Wilsmore 2010), the pedagogical approach to the collaborative learning experience was considered in context of two oppositional models, a 'striated' or 'smooth' approach and a 'complimentary' or 'integrative' approach.

Considering Model 1, a *striated* approach, as described by Alix et al., has 'parameters that are carefully planned in advance so that students are taken through a highly structured experience'. Learning is scaffolded, systematically organised from the start to finish of an activity, linear with expectations of outputs 'concretized' and often requiring preparation for a final performance or presentation.

A *smooth* approach in contrast sees participants 'generate the structures and experience as they go' (Alix et al. 2010:25). Learning happens organically with little to no structure imposed. Students discover their own pitfalls and manage how to respond rather than being 'forearmed to deal with them' (Alix et al. 2010:24). Additionally, no final performance is expected and the quality or 'finished' state of work is subject to negotiation.

By its nature, the design of a games-based activity gravitates towards a *striated* approach with boundaries, structures, pre-defined goals and objectives. Whilst the intention is to enable participants to construct their own knowledge and experiences, this will occur in the distinct game spaces that are created within the structured activity.

In terms of Model 2, a complementary or integrative approach, this considers the boundaries between working 'side by side' and working across multiple disciplines.

In a *complementary* approach, students remain working within their own subject area but collaborate and work with others. Students have a high level of knowledge in their own areas and there are clearly defined disciplinary boundaries. Within an *integrative* approach 'boundaries are not easily observable' (Alix et al. 2010:28), students must acquire skills outside of their own personal practice and their 'creativity becomes increasingly discipline-less' (Alix et al. 2010:28). This mode of working is also known at trans-disciplinary.

The intention of this study has always been to investigate interdisciplinary co-creation. Students from different disciplines working together to create, rather than opportunities built around trans-disciplinary experience where students are able to cross the boundaries between the disciplines in their personal practice. This is an important option for HEIs to facilitate but outside the remit of this research. Therefore, a *complementary* approach is taken in this design.

Having identified the pedagogic approach as using a task-centred, striated and complementary model, the design process will also consider feedback and assessment of the learning taking place. The activity needs to allow for regular feedback opportunities and incorporate a method of evaluating impact on learning. Within video games a feedback mechanic may be used to assist the player with improving their gameplay, engaging them with the narrative. Likewise in this games-based activity the feedback should enable participants to gauge how successfully they are progressing through the activity and contribute towards the activity being adjustable in difficulty. Regular feedback may improve confidence and it has been suggested to be a powerful single factor that influences achievement (Hattie, 1999). Well-structured feedback can guide students and support them with building knowledge. It needs to be constructive, meaningful and, importantly, timely. Feedback from each task will be incorporated into the activity before subsequent actions are taken. As outlined in the Chapter Three (p.64), the primary method of measuring impact on learning will the use of Personal Meaning Maps.

The next step in the design process was to select the skills and characteristics that the activity should focus on developing. To identify these, the researcher referred to the interviews conducted with staff, along with the literature concerning

collaborative learning, as well as example module information forms and personal experience. The table 5-2 shows how these skills and characteristics have been mapped to Bloom's Taxonomy. The design of the activity will support students working through the six levels of thinking outlined here.

Bloom's Revised Taxonomy Levels	**Desired skills and characteristics**	**Example verbs**
Creating	Creating, conceptualisation	Build, design, develop, discuss, imagine, invent, originate,
Evaluating	Critiquing, leadership	Appraise, assess, compare, evaluate, rate, recommend, value
Analysing	Meaning mapping, visualisation, investigation	Categorise, contrast, examine, modify, relate
Applying	Problem solving, negotiation, improvisation	Apply, demonstrate, discover, experiment, manipulate, Solve,
Understanding	Understanding strengths & weaknesses, conceptualisation, intellectual generosity, Communication, planning	Demonstrate, explain, identify, illustrate, recognise, summarise,
Remembering	Organisation, time management	Define, list, memorise, name, order, outline, when, where

Table 5-2: Characteristics of collaborative learning mapped to Bloom's revised taxonomy. (Krathwohl 2002)

Using Bloom's taxonomy can help to scaffold the learning experience and aid the formulation of learning outcomes. Learning outcomes should be easily understandable, measurable, statements that describe what learners can expect from an activity, module or course, depending on the context. Using learning outcomes promotes good practice with learning design and ensures the learning objectives are accurately and meaningfully articulated. Most learning outcomes will follow a similar core-verb construct. Starting with an action verb that indicates the level of learning to take place and followed by a description of the knowledge or skills to be demonstrated.

Example module learning outcomes focused on collaborative learning include the following:

- Apply project management, collaborative and team working skills effectively (BA Theatre & Performance module information form, Falmouth 2017)
- Demonstrate a work ethic that encompasses collaborative and cooperative learning (BA Hons Drawing module information form, Falmouth 2017)

Good quality learning outcomes need to be formulated in such a way that impact on learning can be measured. Learning outcomes drive the assessment criteria; designing learning outcomes carefully and using them as the catalyst for activity and assessment design provides confidence to students, staff and future employers that skills developed are appropriate and relevant.

The learning outcomes designed for this games-based activity are as follows: at the end of this activity you will be able to:

- LO1: Evaluate problem-solving strategies, and work as a team to implement them.
- LO2: Demonstrate the importance of effective communication and the advantages of being able to conceptualise your ideas, visualise others and improvise.
- LO3: Create an artefact through interdisciplinary collaboration with others.

It is good practice to introduce learners to the learning outcomes at the start of the activity. An important element of the striated approach, it supports learners in

directing their attention towards a particular area. If all learners are clear about what they are expected to be learning then, especially within the context of collaborative work, the existence of positive interdependence can be fostered within the group contributing to a productive shared experience and sense of commitment.

5.4 Games design

Having identified the learning outcomes to be achieved through this activity, focus now shifts to selecting the appropriate game type and mechanics. A fundamental aspect in the design of any game is the inclusion of achievable yet appropriately challenging objectives. As a measure of whether players' ability and experience are matched well to the challenges within a game Salen and Zimmerman recommend paying particular attention during play testing to whether participants are 'encountering boredom and anxiety' (2004: 351). They also suggest that these states can act as indicators in terms of meaningful play since, 'both states represent poorly designed moments of choice' (2004: 351). Feedback provided in a game can help to manage these states. As discussed earlier in the chapter, instant feedback has a pedagogical benefit to participants, it is also of importance within a game design context with the potential to increase player engagement and maintain a positive game experience resulting in a higher likelihood of continued game play. This can be achieved through timely feedback, which may be delivered in the form of 'unlockable content', where a task has been performed correctly, or, where participants are struggling, a prompt to use a hint system.

Given the learning outcomes of this activity, it is essential to design frequent opportunities for the group to work together, to create meaningful shared experiences and draw upon the skill set that each individual brings to the group. Including an element of 'shared discovery' and/or shared triumph can be an effective method of enhancing the feeling of 'togetherness' or group cohesion.

5.4.1 Brief outline of the games-based activity

This chapter now moves on to account for why each element of the design was selected. Before doing so, a brief outline of the game-based activity is presented to provide context for the discussion that follows.

Groups of between two and six undergraduate students are provided with a starting point from which their locative games-based activity begins. Bluetooth beacons have been located around campus to broadcast challenges, quizzes and instructions which need to be attempted before the next location is revealed. Successfully completing each challenge provides a clue towards one final secret location at the end. Groups are asked to document their journey using whatever medium they choose with the task of creating a collaborative map that reflects their experience. The extent to which individual participants engage with each challenge is not specified in order to maintain an element of voluntary participation (one of the identified game characteristics underpinning the design).

Keeping the game simple and using the Learning Mechanic-Game Mechanic (LM-GM) methodology ensures that the mechanics are mapped to the learning outcomes. This activity is only intended to be an experimental prototype with which to test the design process and underpinning methodologies, therefore there was no emphasis on presentation. Having said that, both in the prototype, as in a fully developed version, the user interface needs to be simple, intuitive and easily navigable.

Game type

A puzzle game type was selected as the game genre for this activity due to its suitability. Importantly puzzle games can be designed with a low barrier to entry, no prior knowledge is needed, and most people are familiar with the concept of puzzle, whether that is in a digital format or not. The act of trying to solve a puzzle encourages collaboration from a group working towards a shared goal. A puzzle game allows for many different types of puzzle within the one game, making it possible to draw upon multiple skill sets that may be present within the group.

Additionally, the act of solving puzzles as a team can lead to a feeling of shared triumph, identified as a desirable state above.

A puzzle game allows the flexibility to include both digital and physical elements in the game, again providing more scope for the group to draw upon their personal creative practice. Most puzzles can easily be adjusted to be more or less challenging, or, amended in some other manner, as a result of an iterative design process based on participant feedback.

Game characteristics

The next stage of design is to consider the characteristics of this collaborative, locative, puzzle type game-based activity. This will highlight the *game-like* elements of the activity and help determine the selection of mechanics. The emphasis here is on *game-like* as the intention set out early on in this research has never been to create a fully realised game, more an educational activity that is game-like. The following game characteristics represented in this design have been selected from the list of ten identified by Whitton (2010) in the Contextual Review (Chapter Two p.22).

Challenge – 'Tasks require effort and are non-trivial' (Whitton 2010: 23).

The activity is made up from a series of different puzzles which by their very nature will be challenging. The intention is to design these puzzles so that they require group effort in order to successfully solve them. Games traditionally have a fail state whereby if the player performs badly, they will have to restart or not complete. For the purposes of this learning activity there is no true fail state, groups will be able to progress through the game if they cannot solve one of the puzzles. However, in order to motivate participants and give added meaning to successes and failures, each completed puzzle will provide a piece of information that can be joined together to find a bonus area at the end.

Exploration – 'There is a context sensitive environment that can be investigated' (Whitton 2010: 23).

The locative nature of this activity provides an outdoors environment in which participants will be moving around as a result of actions they take within the game. Exploration of the environment will be incorporated into the actions required to solve some of the puzzles. Exploration of a campus they are only partially familiar with is also likely to be a feature for many of the participants, although this will be secondary to the game play itself.

Goals - 'There are explicit aims and objectives' (Whitton 2010: 23).

Each puzzle will have an explicit objective. The visibly explicit aim of the activity is to complete the puzzles. Pieces of information that can be pieced together provide a bonus location for groups that successfully manage to complete each challenge – this additional goal is made known to participants at the start of the activity. There are hidden aims and objectives linked with the learning outcomes and skills being developed, which are not made explicit to participants however will be presented after the activity has been completed.

Interaction: 'An action will change the state of play and generate feedback' (Whitton 2010: 23).

There is interaction with the Bluetooth beacons used within this activity, as discussed in more detail further on in this chapter (p.120). These interactions will change the state of play with feedback being generated by the beacons dependant on the actions that have been taken.

People: 'Other individuals take part' (Whitton 2010: 23).

The fundamental characteristic of this activity is that of people working together. The challenges and tasks required of participants during the activity are designed to promote collaboration.

Considering these game characteristics in the context of the proposed activity ensures that the final design remains playful and game-like. It also assists with identifying the specific mechanics that will best support both the game design and the desired learning outcomes.

5.4.2 Game mechanics

Jesse Schell's definition of game mechanics and the categories that he proposes have been subscribed to throughout this study. As stated in Chapter Three these definitions of mechanics are rooted in a design philosophy, as opposed to serving a purely technical purpose, and this chapter now outlines why Schell's categories are particularly suited to underpinning the design of this locative, collaborative, puzzle type activity.

Mechanic 1: Space. The activity is locative and based in an outdoor environment. The game space comprises of a series of areas in which puzzles take place. Each space related to the next by the journey participants make between them and the experiences they have there. One 'bonus' game space will only be accessible if participants successfully complete all puzzles.

Mechanic 2: Objects, attributes, and states

Each Bluetooth beacon is an object and has an attribute that participants can affect. The state of this attribute is either solved or unsolved. Some of the specific puzzles involve physical objects which participants need to manipulate (to change the state of their attributes) in order to create a solved state. These objects include jig-saw pieces, flags and the beacons themselves.

Mechanic 3: Actions

In a traditional digital game, the actions available to the player at any specific time are determined by the game's rules. In this activity, because the participants are not constrained in this way, the range of actions that can be taken at any time are practically infinite. However, within the context of this study the researcher is concerned with the actions that can be taken which affect the attributes of the various objects relevant to progression in the game. Each puzzle will require participants to interact with it and each other in a different way to encourage skills required for collaboration within the group to be utilised.

Mechanics 4: Rules

This category is not implemented within this study. As explained in the Chapter Two (p.25), the researcher is working from the premise that the rules govern how the mechanics interact rather than functioning as discrete mechanics in themselves.

Mechanic 5: Skills

This category of mechanic is important as the purpose of this activity is to develop a particular set of skills as identified in the learning outcomes. To achieve this, consideration needs to be given as to designing appropriate puzzles and specific mechanics which require the use of these skills. The links between the skills and the chosen mechanics are shown in table 5-3 below.

Mechanic 6: Chance

Seeing as the activity is not set within a controlled environment, elements of chance may creep in that are not designed. This is always going to be the case where there is human interaction and/or reliance on the experience or skill sets of participants.

The categories above provided a useful starting point for identifying the specific mechanics to design into the activity. The skills required to meet the learning outcomes were referred to and mechanics that supported the achievement of these were chosen.

The puzzles are all designed to activate the skills required for collaboration, an essential set of skills to develop as highlighted by both the interviews with staff and the module information forms. However, the puzzles in this game whilst requiring creative thinking to solve do not require the application of personal creative practice. The inclusion of this element of the collaboration has been achieved by an overarching in-game task that participants are introduced to before commencing the activity. Participants are asked to collaboratively create a 'map' reflecting their game experience; it is made clear that this 'map' does not need to be in a traditional cartographic style but is intended to be primarily an interdisciplinary

collaboration. It may result in a multi-media output and can be presented in any medium or on any platform they wish. The process of creating this piece of work is woven into the game experience, rather than a 'bolt on' task at the end and, as outlined in below in Table 5-3, the skills expected to be activated by this creative task are those of conceptualisation, improvisation and visualisation. The actions, experiences and journey taken during the activity will have a direct influence on the outcome of the creative task and ensure the process is organic and integrated.

As participants progress through the activity, they are increasingly being required to use higher levels of thinking according to Bloom's taxonomy and partake in collaborative problem solving. By the time they have completed the activity, they are working at level six of Bloom's levels of thinking, collaboratively creating an artefact, implementing skills that have been developed along the way.

Table 5-3 includes the task participants are asked to do, the mechanics that are implemented, the skills that should be activated and the learning outcomes these apply to.

- LO1: Evaluate problem-solving strategies, and work as a team to implement them.
- LO2: Demonstrate the importance of effective communication and the advantages of being able to conceptualise your ideas, visualise others and improvise.
- LO3: Create an artefact through interdisciplinary collaboration with others.

Task /Puzzle	**Game mechanic**	**Required skills (as mapped previously to Bloom's taxonomy)**	**Learning outcomes**
Entire puzzle sequence	• Cascading events • Exploration	Problem solving Negotiation Visualisation	LO1, LO2, LO3
P1. Riddle and a light sensitive puck	• Riddle • Exploration • Physical manipulation	Problem solving Improvisation	LO1, LO2

P2. Quiz which requires Exploration and individuals each having their own task	• Exploration • Party roles • Jigsaw puzzle • Logic puzzle	Problem solving Communication Organisation Investigation Visualisation	LO1, LO2
P3. Riddle and a heat sensitive puck	• Riddle • Exploration • Physical manipulation	Problem solving Improvisation	LO1, LO2
P4. Riddle and a memory game	• Riddle • Exploration • Memory game • Party roles	Problem solving Negotiation Organisation Communication	LO1, LO2
P5. Physical task and quiz questions	• Exploration • Group measurement • Non-verbal communication • Party Roles	Problem solving Improvisation Communication Organisation	LO1, LO2
Secret location	• Combining information • Exploration	Problem solving Improvisation Organisation	LO1, LO2
Collaborative map task	• Player roles • Group creation	Planning Time management Improvisation Visualisation Conceptualisation Critiquing Intellectual generosity Creating	LO2, LO3

Table 5-3: Outlining the mechanics, required skills and related learning outcomes for each game space.

5.4.3 Artefact creation opportunities

The piece of collaborative work that is produced as a result of this games-based activity allows for participants to have complete group autonomy. The methods used for mapping, curating and presenting are not dictated and the group can manage its own working practice. Enabling this level of ownership over the work will provide scope for continued development of the piece beyond the remit of the in-game task if desired. Perhaps with the development of ePortfolio systems and the increasing focus on lifelong learners there will be better mechanisms in place for enabling this functionality of accessing and building upon work within the intuitional domain. However, in the absence of this at the time of the study, this activity has been designed with the option for learners to access their work indefinitely by including it within their portfolio platform of choice.

As noted in the Contextual Review, student-led collaboration requires clear guidance, contingency plans to support unexpected outcomes and consideration over IP and ownership. Within the design of this activity, in keeping with the ethos of encouraging interdisciplinary collaboration and intellectual generosity, participants are encouraged to consider applying a Creative Commons license (2019) to the final piece. This takes any ambiguity away in terms of what consists of the 'finished piece' and allows for others to continue developing the work. It will not always be appropriate for groups however, yet it serves as an insight into how to manage one aspect of collaborative creative practice post-University.

5.4.4 Data collection and assessment

Rigid assessment policies frequently hinder the ability of academics to design learning activities as they wish – as noted by Interviewee 5 earlier in the chapter (p.101), particularly for collaborative tasks. Assessment methods around collaborative creative practice can be quite subjective and prove problematic when adhering to institutional requirements for assessment criteria. Assessment criteria can also prevent learners from finding their own path, forcing constraints on what

is permitted to be created. This may result in learners reluctant to engage or perhaps finding inventive ways to circumnavigate the rules. The first assessment consideration in the design of this study was how to introduce assessment, keeping in mind these barriers, closely followed by when to have these assessments points. Personal Meaning Maps, as introduced in Chapter Three (p.64), address those concerns since they allow for personal expression without restraint by having a clear framework from which to assess impact on learning (as required by most institutions) whilst avoiding the use of pre-determined fields. Additionally, although it isn't in the remit of this research, these assessment methods could easily be used to measure the long-lasting impact of the activity on participants by repeating the Personal Meaning Mapping at a later date. This method would also be backed up by the more traditional form of assessment, observation, during the games-based activity.

Iteration and evaluation

The design needs to be responsive so that feedback from participants can be considered with an iterative response. Through having distinct game spaces and puzzles this allowed for modifications to be carried out without needing to re-design the entire activity. There is scope for these changes to be large, for example an entire puzzle could be replaced with a completely unrelated task, or small – a minor adjustment to an individual element of a puzzle. This type of design then allows for consistency across multiple iterations and the ability to compare and contrast experiences across the iterations more easily.

5.5 Hardware

The locative nature of this games-based activity meant that participants would be moving across campus and would need to engage in puzzles at specific locations. The intention was to provide regular interventions that would require the group to work together in order to progress but the question of how to instigate these interventions needed considering. Various methods were considered from basic physical objects such as posters or paper-based instructions (not resilient enough)

to QR codes (quick to transfer information, but no interactivity) and in person delivery (reliable yet a constant interruption to the group dynamic from an outsider, along with the potential for outside influence). The launch of a new type of Bluetooth beacon, Puck.js (Williams 2017), essentially a microcontroller that could be programmed using Javascript, presented the possibility of using a hardware transmitter to provide the required interventions.

Bluetooth beacons are low energy devices that encompass a Bluetooth transmitter. The beacon broadcasts data such as a web link or can trigger an action in a mobile app. Initially using a Bluetooth beacon for the activity has been discounted as up until recently these have been broadcast only, used mainly for way finding or for sharing resources (Glover and McDonald 2018). The introduction of a beacon that could also be a Human Interface Device (HID), meant that these could be used in situation where active learning could take place as participants are able to interact with the beacon as opposed to passively receiving information.

The Puck.js beacon contains a magnetometer, infrared & RGB LEDs, temperature and light sensor all within a silicone cover with a tactile button. It can be used autonomously, controlling other Bluetooth devices within range or as an interactive beacon delivering information to a mobile device via an app. The decision was made to utilise these features and deliver the games-based activity using the Puck.js beacons.

Figure 5-1: Puck.js Bluetooth beacon (Espruino, 2017)

This hardware was unlikely to be something that the participants were familiar with and interacting with it would add to the 'puzzle' nature of the activity. They could be hidden (either accessibly or not, depending on whether interaction was needed) and broadcast to a range of up to eighty metres, however in tests carried out during this study 35/40 metres was the average. The ability to reprogram the beacons, and the variety of activities in which they could be applied also ensured these were a sustainable purchase and could be used for future games-based (or other) activities once this study was completed.

Simple uses that would involve interaction with the beacon would including broadcasting a URL (to a webpage with information relating to the challenge) that would change based on user input, for example if a user presses the button three times. Other examples that were used in this study include the broadcast changing based on the temperature of the beacon (groups had to warm it up) and also based on the light levels (groups had to put it in a dark place). Some basic coding of the beacons was undertaken by the researcher with more complex commands coded by a game programmer from a local games company. The design of this games-based activity requires game spaces and tasks that are easily amended to allow for multiple iterations. Since each beacon is individually programmed using JavaScript, adjustments to the code for a single puzzle have no impact on the other beacons or tasks. The syntax of JavaScript is considered fairly easy to learn with many tutorials available freely; the beacons are supported with a graphical editor so that no specific software is required. Debugging and testing are straightforward since code is interpreted line-by-line and errors indicated with line numbers, making it quick to pinpoint errors in code, correct and test again. Programming and debugging happen wirelessly meaning making changes on the go is possible where required.

5.6 Design for V1 games-based activity.

The learning and game mechanics have been selected specifically for this design as outlined above, however a clear overview of the activity is a useful reference point both for this researcher, as well as others looking to create their own activity. The

Learning Mechanic-Game Mechanic (LM-GM) map below provides a visual representation of the game space, mapping the learning mechanics against the game mechanics to ensure each element of the games-based activity design is justified in terms of the learning outcomes that have been determined.

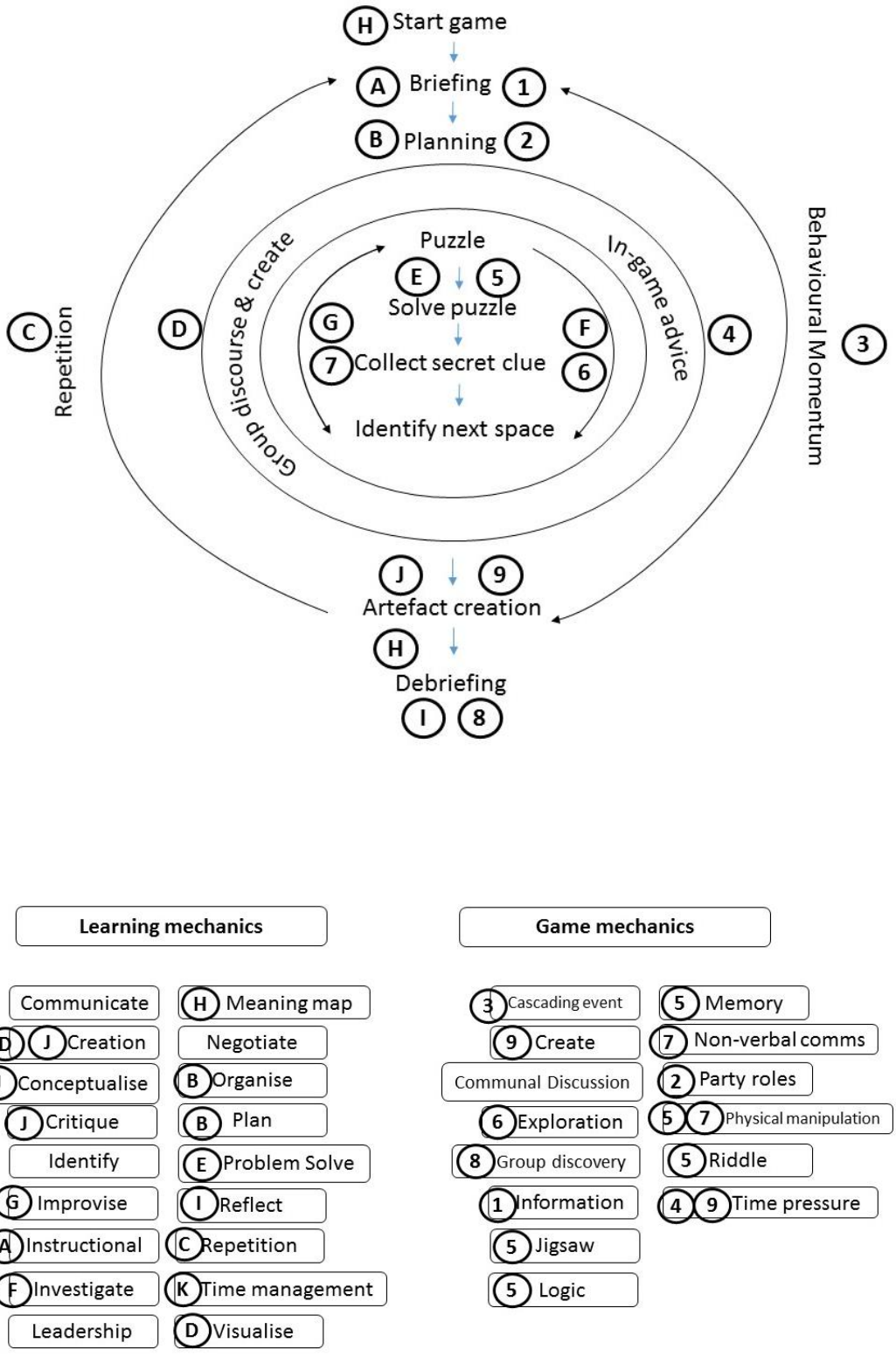

Figure 5-2: Visualising the relationship between learning outcomes and games mechanics
Based on Arnab et al. (2012) LM-GM model

Not all of the learning mechanics are specifically identified on the LM-GM map. These are skills that are expected to be activated through participation in the activity as a whole. As the map shows, participants begin by completing the Personal Meaning Map, after which point there is a briefing and activity introduction. The game-like nature of the activity is described and the overall task of creating a collaborative 'map' is set. At this stage participants are given a 15 minute planning stage to organise how they may record or map their journey and experiences; they are encouraged to consider party roles, the variety of disciplines in the group as well as how that content may be collated later.

Participants then enter the game space of the activity, moving through the puzzles in a sequential order. Whether the puzzle is solved or not there is the option to move onto the next one. Successful completion of puzzles results in additional clues to the final bonus game space. The riddles and exact wording of the puzzles are outlined in the following chapter, 'Implementation'.

After groups have worked through the game space, attempting the various puzzles and creating a record of their journey and experiences they are provided with one hour in which to collate the material into an artefact that represents their experiences. The activity concludes with returning to the Personal Meaning Maps followed by debrief and discussion.

In conclusion, the process of identifying the learning outcomes and ensuring that the game mechanics support these, has been outlined both textually and visually in this chapter. Revisiting the design criteria, this chapter has also demonstrated that these criteria have been upheld:

- Suitable for students from a range of Creative Arts subjects to participate in

The activity has been designed to enable students to participate in way that is appropriate to their discipline. The in-game collaborative creative task does not

impost any limitations or restrictions, other than time, on how the experiences and journey are recorded, collated or presented.

- Allow for an outdoors environment and movement.

The hardware chosen to support the activity are small, portable and weather resistant. The design of the games-based activity promotes movement through travel between game spaces.

- Low barrier to entry

From a participant perspective there is no prior knowledge required to interact with either the hardware used or the structure of the activity. From an academic position the activity can easily be adapted for any location and the hardware / software used is not complex.

- Accessible

All content is delivered via browser which will be compatible with any accessibility software a participant may use. Although the activity requires moving between locations specific directions are not provided, therefore participants can choose the most accessible route between game spaces.

- Participatory design orientated

The activity has been designed in such a way that there is opportunity for participants to feedback on their experience and provide suggestions as to how they think it could be modified. The way the games-based elements are individual (yet tied together by the creative activity) means that an iterative process is straightforward to implement. Whole puzzles can be replaced, or small tweaks can be made, without impacting on other areas of the activity.

- Documented and transparent

Documentation of the learner progress and experience is built into the game through the inclusion of Personal Meaning Mapping at the start and end, a debrief and feedback session to conclude, as well as, for the purposes of this research study, being observed during the games-based activity itself.

This chapter has addressed the following research objectives of this study.

- The characterisation of game mechanics; identifying specific mechanics that will support individual learning outcomes.
- The creation of an experimental prototype to measure the impact of game mechanics on learning outcomes.

One final point of importance to note before moving onto the implementation of the activity is acknowledging that the nature of this design is a prototype. A prototype is itself a stage of development and the purpose is to discover if an idea works in practice. The prototype is designed to provide insights into how effective the puzzles are at activating the desired learning mechanics and indicate how successful this method may be at having an impact on learning. It is not, at this point, designed to be a polished, fully realised exercise, more an impression of what the finished gameplay may look like.

6 Implementation and iteration

This chapter presents and discusses the implementation of the games-based activity. It goes on to consider the context within which the prototype was delivered, and the reasons behind these decisions, as well as the practical considerations for running such an activity on campus. The methods used to recruit participants are outlined along with the challenges this entailed. Additionally, the considerations in terms of how students were selected, group sizes and disciplines are elaborated on. The chapter then goes onto present the puzzles used in the game-based activity. A detailed run through of the game spaces including how feedback and observation informed the amendments made within each iteration is discussed. Finally, the chapter concludes with a review of the impact that a Design-Based Research approach had on the implementation of the activity and evaluates how truly participatory was the experience produced by the game design.

6.1 Context of prototype

Various pathways were considered for the context in which this activity was offered to students. Whilst the impact of the activity on learning outcomes in comparison to traditional methods would be most easily visible through a direct comparison, there were ethical and practical barriers to this route. It was not appropriate to introduce an untested activity and assessment wholesale into a credit bearing module. Students expect, and are entitled to know, that the pedagogical methods used are sound and that they are designed to have an impact on their learning. Rather than introduce an untested activity to a whole cohort an alternative method could have been to recruit a group of students who provided consent. This option would benefit from simultaneously having a large control group from the rest of the cohort. Although this would present an ethical dilemma in that if the newly introduced activity resulted in a significant improvement to students learning the control group will not have had the opportunity to progress and develop those skills, which then has the potential to create a disparity with grades.

In addition to the ethical barriers surrounding incorporation of the activity in modules there were administrative barriers regarding the procedures involved in amending module activity and assessment within the researcher's institution. At the time of the study, module content (for every course) was approved through relevant quality assurance committees and therefore set in place entailing that there was no scope for amendments over the following 12 months. As a result, the decision was made to run the games-based activity outside of a credit-bearing module, focusing on the testing of the conceptual framework and methodologies for designing such an activity, with a view to ensuring the correct instruments were tested for evaluating impact on learning. Should these tools and methodologies prove effective in the prototype then further extensive implementation would be recommended.

A campus location for the activity was selected due not only to the convenience but also to introduce an element of shared discovery in a familiar environment. Although the campus is not particularly large (100 acres), there are many areas that unless specifically sought would not be known to an individual. A secondary, non-research-based, purpose of this activity became to introduce students to some of the more hidden and rarely visited areas of the campus. Often campus-based games tend to focus on provisions such as the library, student services and resource discovery, often acting as an induction aid (Armstrong 2018; Lallie 2015; Piatt 2009). The locations used in this activity were selected based on how unlikely it was that students would be familiar with them or come into contact with them in day-to-day campus life. Participants were offered a campus map to assist in locating the next game space. Consideration at the design stage was given to the accessibility of the separate game spaces and the journeys that had to be made between them.

As with any organised activity on campus a risk assessment was undertaken; Site Services were also informed that items were going to be hidden around the campus. Each Bluetooth beacon was also clearly marked as part of a research project with contact details of the researcher included.

6.2 Recruitment of participants

The ability to communicate to all undergraduate students was surprisingly challenging. After seeking advice from academic staff, Student Guild and Professional Services staff, multiple communication channels were used.

The added incentive of lunch and a drink provided was included as a fair exchange for a student's time. Flyers and a poster (see Appendix four) were printed and left in the main social areas on campus. A Facebook page was set up with more information about the research, making it easy for people to share an invite to the event with others. Requests for participants was also shared through the Guild Facebook page and the Games Academy page. An unforeseen benefit of doing this was the positive feedback from previous participants encouraging others to take part.

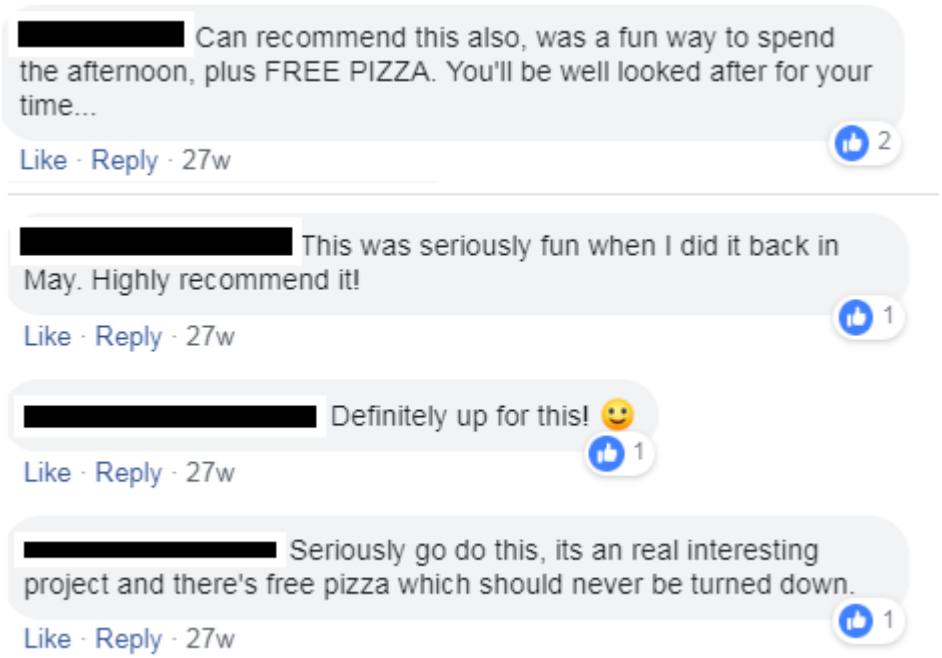

Figure 6-1: Using Facebook to recruit.

Members of the Student Guild also shared news of the activity when speaking to groups of students at the start of the academic year and e-mails where sent by academic staff to their year groups.

The sample of students selected for this study were undergraduate Creative Arts students since it was this group that the study was focused on enhancing interdisciplinary working skills for. From a practical standpoint this cohort of students were present within the researcher's institution. The initial intention had been to incorporate the activity into a credit bearing module, however, as outlined earlier in the chapter, this was not permitted. Instead participants were recruited from those who registered interest, and then narrowed down to a selection who could each make the same date, alongside the greatest variety in disciplines and stages of study. It needs to be acknowledged that participants were self-selecting initially by volunteering to partake. Therefore, those who took part may have been more motivated or open to the idea of us using game-like activities for learning than others. The researcher attempted to encourage those who had experience of game playing as well as those who did not, however, since the activity was not mandatory, this research was reliant on volunteers to test to the prototype.

In order to enable the maximum opportunity for interdisciplinary collaboration, the decision was made to recruit from multiple disciplines, ensuring each participant was skilled in a different discipline. There was no attempt to match subject areas with others. Logistically this was quite straightforward as group sizes for the games-based activity was to be between 2-6 participants per run.

As with Squire's (2005) study, discussed in the Chapter Three (p.55), the activity has a low participant to facilitator ratio, the reasons for this are near identical to those of Squire. In order to accurately observe and record the participant's actions numbers needed to be limited, especially in early iterations. Additionally, a games-based learning environment may be unfamiliar to some students and assistance with orientation was a necessity. As the iterations progressed and the designs improved, less assistance with orientation was needed as the design become more user-friendly.

The decision was made to recruit participants for the first iteration from the Games Academy at the university. There were three reasons for restricting to this cohort in the first instance. Most importantly, it was recognised that these students were very used to constructively critiquing games and game-like activities. With the first

iteration, the researcher felt it was essential to 'sense check' the concept to ensure the game-like elements came together in a fluent way. The students from the Games Academy work in teams designing games and were likely to have the confidence to identify issues with game play and offer solutions without it being seen as a negative or awkward process. This meant the researcher was more confident that basic game play issues or flaws were more likely to be vocalised by this group. Additionally, these students, although all on the same course, were made up from a variety of disciplines. Students could be following different streams of study including Game Art, Design, Animation, Audio, Writing or Coding. By ensuring that a selection of students from across those disciplinary streams were chosen, there was still the element of interdisciplinary collaboration that this project is focused on. Finally, communication with this cohort was easier as they, as well as this researcher and other academic staff, were all based in one department.

6.3 Challenges

Recruitment transpired to be the most challenging aspects of this research study. With the possibility of incorporating into credit bearing modules removed, the researcher was reliant on volunteers. For example, despite sharing information across a variety of approved channels, the majority of recruits came via a post on a community-based Facebook page, *Penryn FitFinder,* that many students are members of. This page is a community page (unrelated to any official university social media channels) aimed at students on campus for sharing events, requests, memes and general chat. The benefit of using this channel meant that a wide variety of undergraduates got in touch, however one of the challenging aspects of this mode of contact was a lack of commitment from those signing up. There were *nine* occasions where a trial of the prototype needed to be cancelled due to no-show of participants or withdrawal at short notice. Since the task was a collaborative working exercise, it could not be run with a solo participant. This issue is not unique to this study. Squire's 2005 study encountered similar problems with ensuring participants in a sample group completed a pre-test. Whitton (2010) also

found recruitments rates low for her games-based testing until it was incorporated formally into a credit-bearing learning activity.

To incentivise take-up, students were offered lunch (pizza) and a free drink. In the design stage of this research study, a decision was made to not offer financial incentives, partially due to uncertainty as to how this may be funded, and partially due to the concern around the motivations of participants. The question that payment raised was: would students be completing the task in the way they *thought* it should be done rather than how they naturally would in order to ensure financial recompense?

In addition to the challenge around recruitment, the other challenge experienced by the researcher before the prototype testing even got started was that of weather (we are located in Cornwall after all). Due to the entirety of the games-based activity being located outside, the study was always at the mercy of the weather. Testing was cancelled on several occasions due to rain, snow (unforeseen given, as stated we are in Cornwall!) or high winds. Unfortunately running the event over the summer when better weather was likely proved even more problematic due to the lack of undergraduates on campus at that time. When considered alongside the challenge of getting multiple participants available on the same date at the same time, these cancellations were incredibly frustrating, and, in all cases the group was amended before it could run as the same people were no longer available.

6.4 The iterative process

Participants in Iteration One were recruited from the Games Academy within the researcher's institution. A call for volunteers was posted on the course Facebook page and achieved a good response rate. The sample was selected based on taking participants from across the year groups, a mix of genders and each participant from a different discipline. Disciplines included a second-year programming student, two second-year game design students, a second-year game art student, a third-year game writing student and a third -year game art student. As with all the

iterations, a seminar room was used as a base from which to brief the group and carry out the Personal Meaning Mapping and creative collaborative task. Participants in Iteration Two were recruited via social media and an e-mail from Class Rep's to various cohorts. Disciplines included a second-year creative writing student, a second-year fine artist and a second-year game artist. Participants in Iteration Three were recruited via social media and posters. Disciplines included a third-year game artist, a third-year design student and a third-year animation student.

In all the iterations, beacons were set up earlier in the day, battery levels tested and all beacons were clearly marked as being part of the research project. In Iteration One, despite having been tested two days earlier, a challenge was immediately presented in that the mobile device used by the researcher was not picking up the beacon's broadcast. Investigation revealed that Google had removed the Chrome browser physical web extension that enables a device to pick up a broadcast URL without having to use an app. The cause of the issue was not immediately apparent and for the first iteration the researcher accompanied the group providing the cues and interruptions that the beacons were broadcasting. In subsequent iterations this issue was resolved by asking that at least one participant in the group download an app onto their phone that enabled the location of physical web devices such as the beacons. A mobile device was available to use in the event team members did not want to or could not install the app.

The researcher was already mindful to take steps that minimised the Observer-expectancy effect, however, given the issue around picking up the beacons, there was much closer interaction in this first iteration than originally intended. The Observer-expectancy effect is concerned with the how a researcher's belief in a hypothesis could influence the actions of the participants. Up to this point the language used in terms of introducing the activity and the purpose of the research was neutral. If the researcher's language and actions were putting across the expectation that collaborative learning may be more effective using games-based activities, then this could influence the behaviour and Personal Meaning Maps of the participants.

In terms of being near to the groups as they completed the activity, the researcher was conscious not to react towards the groups working effectively together, struggling with the puzzles or other behaviours. A passive bystander approach was taken and often the researcher's presence was ignored once the groups became absorbed by the challenge. Where the observer was called upon for advice or clarification it was noted in order to amend following iterations so that groups could work through the activity without support. The researcher attempted to be as unobtrusive as possible when taking notes or pictures for the purpose of recording observation. Unfortunately, the images from Iteration Two were lost due to the researcher's phone being damaged before they were transferred.

6.5 Activity walk-through

Participants were provided with a brief over lunch. The briefing included ensuring that each group had a mobile device suitable for picking up the beacons, explaining the in-game task of a) recording the journey, and, b) producing a collaborative piece of work at the end. It also included answering any queries or questions that participants had. An information sheet regarding the aims of the research was provided along with a consent form (see Appendices one and two). Once lunch was finished, each participant was provided with an A3 piece of paper with the word 'Collaboration' printed in the centre and they were asked to add to the paper with any words, images, phrases that came to mind when thinking about that word. The researcher observed the format of 'brain storming' was familiar to all and that each participant undertook the Personal Meaning Map individually. From here, each group was taken to the starting location, asked if they had any questions and then asked to begin.

6.5.1 Games space one

In Iteration One, due to the beacons not being picked up by the phones, the researcher presented the group with the first clue; subsequent groups received the starting puzzle via a notification on their mobile device:

> *The PL ace I'm hiding, near the Oak tree, sculptural, once white, now streaked with green, I am seen.*
> *Once you find me I'd like to sleep but it's too light right now, can you help me dream?*

The clue contained a hint as to the building in the general area that they need to be in (PL = Peter Lanyon building), reference to a significant landmark (there is a large Oak tree which is fairly prominent on campus) and then a clue leading the group to a sculpture that sits nearby. The aim of the riddle was to locate the beacon and put it somewhere darker so that a new location was broadcast.

Group One worked together by using coats to create a dark space. Group Two put the beacon under a member's T-shirt. Group Three tried a number of approaches (including singing a lullaby) which did not work until they figured out they had to reduce the light reading and then enclosed it in hands. This game space worked well and was not amended throughout the iterations. It functioned as a good introduction to the beacons and also prompted the group to discuss, interact and problem solve. Feedback from groups indicated that they enjoyed the novelty of being able to interact with the beacon and that 'it was a fun first task with other people in the group, I didn't know them but it got us working together' (Participant Three from Group Two).

Figure 6-2: Group Three reducing the light metre reading on the beacon.

When the group successfully managed to reduce the light metre reading on the beacon, a new notification was picked up on their phone providing the clue to the next location.

> *Past the house and fishpond, a little blue shelter at the top of some steps. Once you're here take my quiz*

6.5.2 Game space two

In the first iteration of the game the quiz was quite static and all based around questions on the screen of the mobile device, as in Figure 6-3 below.

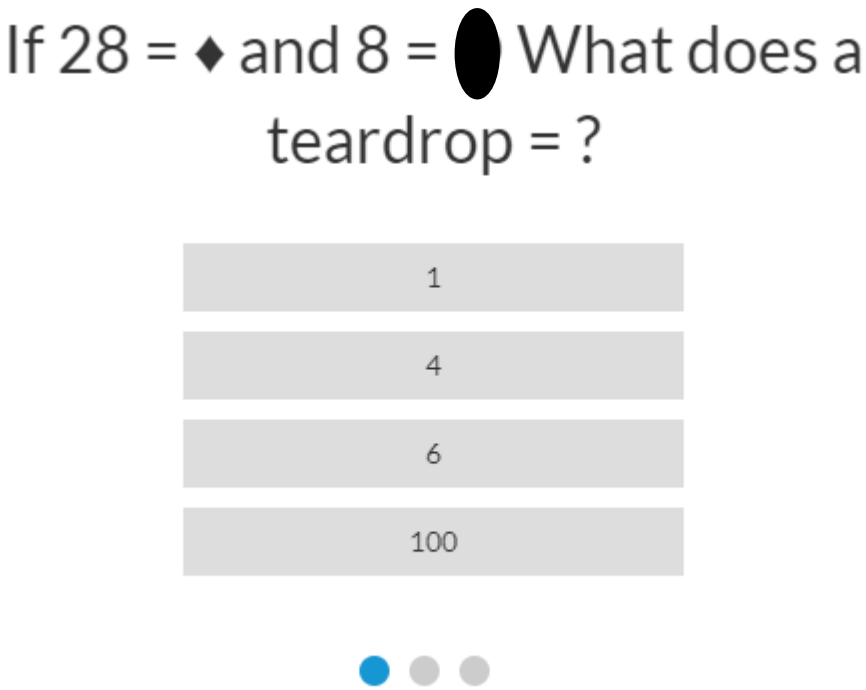

Figure 6-3: Screenshot of first quiz question, Italian Gardens.

The question in Figure 6-3 relates to the blue structure that the group had travelled to (Figure 6-4), the intention was that by observing their surroundings they could deduce the answer.

Figure 6-4: The environment provided the answers to the clues.

Group One did not manage to answer the question correctly and therefore did not get the clue to the secret location, however using the 'help' function they were able to move on to the next location. Observing the group, it did not seem as though working on the questions triggered participants to use the skills required for collaborative work. The participants were working as individuals, figuring out the answer to questions rather than working as a group. Therefore an amendment was made to the design of this puzzle and in Iteration Two a photo of the blue hut above was provided. This resulted in the group coming together to look over the image. As a result there was a greater demonstration of communication skills but the collaboration still did not result in a correct answer. Feedback from both groups indicated that this puzzle isolated them rather than to bringing them together. 'When we were stuck in the gardens we didn't want to give up but had no idea what to do. Everyone became quiet and tried to figure it out' (Participant Four from Group One).

In Iteration Three, the photo was divided into jigsaw pieces and then hidden in four areas of the Italian Gardens. Also, included on the image was the quiz question

above. The party roles game mechanic was activated by providing each group member with a clue as to where their puzzle piece was, additionally the exploration mechanic was implemented requiring participants to separate and explore the area. They had to retrieve their piece of the puzzle and then come together as a group to make the picture. Each member of the group had part of the quiz question on their puzzle piece and the separate roles appeared to ensure that each individual actively engaged with solving the puzzle. There was therefore a demonstration of collaborative working skills including problem-solving, communication, investigation and visualisation.

Figure 6-5: Group Three bringing together their pieces of the puzzle and then solving the riddle.

Group Three did answer the question correctly and were the first group to successfully solve this game space. ‘I really enjoyed the bit with the jigsaw pieces, where we all had to solve our own stuff which meant we could figure out the answer’ (Participant Two, Group Three). They obtained the secret location clue and triggered the next location without needing to use the support function.

Past the gym, take the lane that leads to spiritual support. Find me resting under a sunny bench.

Despite the sun I am not warm enough, can you help?

6.5.3 Games space three

After looking at a map of the campus, Group One established the correct location. Group Two initially walked to the wrong place on campus before consulting the map provided. Group Three headed to the gym and then saw the signpost for the Chaplaincy and followed that. Each group found a different way of getting to the next location. On finding the beacon, there were discussions as to how to resolve the puzzle including suggestions to put it in daylight (similar to the first beacon) or to hold it up. After some trial and error, Group One decided to warm the puck up. Putting it within one of the team's hands did not warm the beacon up enough so the group used combined body heat and the pizza box to successfully effect the temperature sensor and trigger the next location. Whilst in close proximity to each other, discussions around how to represent this action in their journey took place. The group likened themselves to penguins and considered a penguin theme for their map! Feedback from the group concerned what they would have done should the pizza box not been available. Whilst the researcher was not convinced that the pizza box would have been warm enough at this point to have provided an advantage, before Iteration Two the code that governed the temperature difference needed to trigger the next location was changed. The hope was that it would be easier to reach and it was always intended that using hands alone should be able to heat the beacon. Despite lowering the threshold, Group Two did not manage to warm the beacon enough to trigger the new location; they tried various methods but each only very briefly. Participant One from Group Two stated, 'we couldn't figure out what to do in the courtyard. I thought the white thing needed to be warm but that didn't work so it was confusing'.

The code was once again amended before Iteration Three to make the threshold lower. Group Three placed the beacon in the sun and used hands it successfully warmed and released the next location.

Figure 6-6: Group One halfway through 'warming' their beacon.

Having successfully warmed up the beacon, the new riddle was released:

> *Within these walls the apples grow. Under a studded water tank you'll find me resting.*
>
> *When you find me, start the quiz - Press my button and get ready to note the colours you see.*

6.5.4 Game space four

The groups quickly established the next location as the Walled Garden on campus (although at least one member per group was not aware of its existence). Unaware that the beacons emitted light, each group puzzled over the clue on their way.

Group One found the button on the beacon within about 30 seconds and had already identified a member of the group to 'note the colours'. In this puzzle once the button on the beacon has been pressed a sequence of different coloured LED lights flash. The group had to establish the correct sequence of lights. There are three sequences to identify, each one longer and faster than the last. This is unlikely to be possible by an individual working alone and requires teamwork due to the speed and length of the sequences. This puzzle utilised the mechanics of party roles and memory game with the aim of requiring the use of negotiation, organisation and communication skills.

Through establishing separate roles Group One successfully identified the first sequence. Unfortunately the group also discovered an issue that was not identified in testing – if the button was pressed multiple times in quick succession all three sequences ran and then a delay occurred before they could be run again. This confused the group. With the assistance of the researcher/observer, this was navigated however a note was made to amend the coding for Iteration Two.

Group One did not obtain the secret location clue for this beacon and used the support system to move onto the next game space. Feedback from Group One at the end of the activity indicated that this was their least favourite puzzle, however they liked the idea and recommended keeping it if the code could be fixed. Before Iteration Two was run, the code around the timing between button presses and light sequences was amended to avoid the confusion experienced in Iteration One. Groups would need to press the button once for the first sequence, twice for the second sequence and three times for the third sequence. This amendment resulted in the subsequent groups not having the same problem with generating the light sequence.

Group Two successfully noted the first sequence and then before pressing the button again set out a strategy to successfully identify the following sequences. Each person was assigned either the beginning, middle or end of the sequence to remember. In this way they were the only group to correctly identify all three sequences. As such, nothing was amended in this game space before Iteration Three.

Group Three identified how to solve the puzzle, however they relied on each group member trying to remember an entire sequence. As a result, the second and third sequences were not correctly identified. This puzzle did prompt the group to reflect on how they had ineffectively worked together and immediately a more effective strategy was identified should they come across a similar puzzle. It was this task that prompted Group Three to suggest that a note to participants should be included either at the start of the game or on each question reminding them to read to the end of the puzzle text!

Once the sequences had been entered correctly the following game space clue was provided.

> *Where dancing, music and acting take place, go to the top for a grassy space. Start my quiz.*

6.5.5 Game space five

The groups were all aware of where the Performance Centre was on campus and headed there but had to explore the area to find a grassy space on the roof which each group were unfamiliar with. Group One spent some time discussing the view, finding common points of interest, such as the Games Academy building. The quiz questions of this space used the mechanics that encouraged exploration and required a collaborative physical response. In Iteration One participants were required to explore the area and find the answers to questions in the environment. The final task required them to physically work together to form a circle around the grass.

Figure 6-7: Participants from Group One running after spotting an answer

Figure 6-8: Physical task that required participants to space themselves around the grassy area (Group One).

Whilst the team enjoyed the activities and were engaged, the observer did not feel the tasks activated the skills required for collaboration. The group tended to work as individuals for the first part of the task with no reason or catalyst provided to communicate.

Feedback received from Group One suggested that this final game space was the least engaging, and lacked purpose. Most of the feedback related to the task requiring participants to 'measure' a grassy area, including the following comment:

'I enjoyed all of the puzzles except for the one at the performance centre. It was a bit weird and didn't feel like there was a right answer' (Participant Three, Group One).

This game space was completely changed for future iterations in order to create a puzzle that required greater and richer collaboration to solve. This puzzle was intended to encourage use of skills such as improvisation, organisation, communication and problem solving, which would contribute towards learning outcomes one and two of the activity. In order to ensure better communication, the game space was redesigned so that participants had party roles, with slightly different challenges to solve that when brought together would form the solution. The group were divided in two and provided with instructions as to their roles. Whilst one half solved the exploration type questions on the Performance Centre roof, the other was directed to a bridge at the bottom of campus. At which point they found semaphore instructions along with a word to communicate to the rest of the team. Improvisation was required in terms of how to facilitate the communication of the message, how to establish the start of the communication and to reconvene afterwards.

In Iteration Two there were issues around ensuring that both groups were in their correct locations at the same time and with sending the signal in semaphore. In response to feedback from Group Two after the activity in Iteration Three, a clearer guide to the semaphore symbols was provided and a marker put in the precise points where participants would have a good view of each other.

In Iteration Three, the positioning of markers for each group and provision of a different guide made the practical aspects of the puzzle much easier to manage. Group Three successfully completed the puzzles in this game space and demonstrated the key skills that this puzzle was intended to activate. Problem solving, improvisation, communication and organisation were all clearly demonstrated in the process of completing this game space.

Figure 6-9: Participant from Group Three using semaphore to transmit a message to their group who are positioned on a roof that can be seen in-between the trees on the right.

At the end of this puzzle groups were able to put together the clues they had obtained that led to the secret location. Although none of the groups collected every clue for the secret location, each collected enough that meant they were able to figure out where to go. Groups pieced the clues together using the campus map to identify where the route to the secret location.

Figure 6-10: Group One find the secret location.

The secret location was a pond and war memorial, hidden behind shrubs on the edge of campus and reached from a narrow set of granite steps. Feedback from groups indicated that the novelty of the location, unknown to most, was a suitable 'bonus' prize. Group One suggested that more information about the purpose and history of the feature would be useful for feeding into their collaborative map; in future iterations further information was provided as to the origin of the feature. It had been created by American servicemen based in the town whilst awaiting D-Day, the 'grotto' was a task given to 'keep them out of trouble' (Visit Penryn 2016).

6.6 Post-activity

On completing the activity, the group were provided with one hour to work on the creative exercise. Bringing together the photos they had taken, notes that they had written and thoughts as to how they should create their collaborative piece. Whilst the individual disciplines of each participant was occasionally noticeable during the

activity – based on how they were collecting their material and recording their experience - it was at this point that the different disciplines were more apparent. Despite not being restricted as to what format the collaborative work should be presented in, each group very quickly decided to sketch something on paper initially. There was paper available that had been used for the Personal Meaning Map exercise which may have factored into this decision, or possibly due to the ease of getting everything down on paper quickly. Some groups then used this as the basis for producing a digital piece of work.

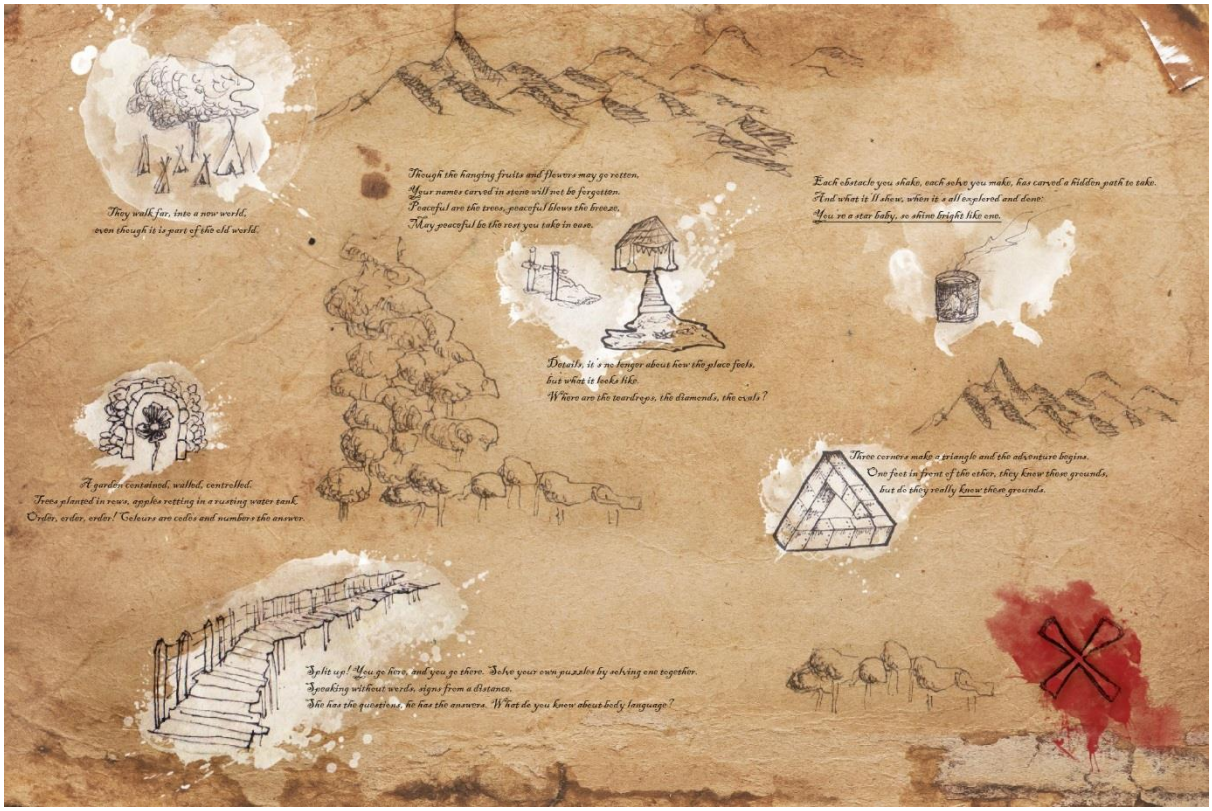

Figure 6-11: Example of collaborative piece from Group Two. (Creative Writing student, Fine Art student and Game Art student).

Finally, the group were asked to revisit their Personal Meaning Map, adding any additional thoughts, experience or knowledge about collaboration to the map, with a different coloured pen. Most appeared to add to the Personal Meaning Map straight away, and with little guidance. Two participants struggled to expand on their maps, in these cases the researcher prompted them to recall times at which they worked with others during the activity and to reflect on those times. The

following chapter will analyse and score the meaning maps, within the context of impact on learning outcomes.

Participants were then asked to feedback with any observations or suggestions they had regarding the activity and what they felt worked or did not work. Feedback from students has shaped the final design, being the catalyst for each iteration and having a direct impact on those who did the activity after them. There have been challenges with incorporating participant feedback into the design primarily around some of the suggestions not being realistic or appropriate.

The initial response to game was positive with comments including:

'really enjoyed seeing places that even having spent most of my life in Falmouth I didn't know about' (Participant Three, Group One).

'wish this had been an induction activity' (Participant One, Group Two)

'good way to meet people from other subject areas, I usually only see people from Games Academy' (Participant One, Group Three).

There were also positive comments related to engaging with the activity

'it felt really good when we solved the puzzles' (Participant Two, Group One).

'really interesting how we approached things from different places' (Participant Two, Group Two).

'it's making work fun' (Participant Five, Group One).

In addition to the feedback regarding specific game spaces, general feedback fed into the iterative process and contributed to a better experience for future groups.

'a reminder to read the whole clue would be good as we didn't' (Participant Two, Group Three).

'would be good to have the individual having specific tools or responsibility' (Participant One, Group One).

There were some suggestions that couldn't be included in the design:

'warmer/incoming pips as you approach the beacons' (Participant One, Group Two).

'use of 360 headsets would be fun' (Participant Two, Group One).

'More time to complete the collaborative artistic exercise' (Participant Two, Group Two).

'A narrative to the activity (Pirates!)' (Participant Four, Group One).

Managing the expectations of participants became apparent when suggestions from Group One included use of 360 headsets. With future iterations the boundaries around what was realistic (amending puzzles or adding activities) was contrasted with what was not (changes that would require the purchase of technology or significant upskilling to implement). The impact a Design-Based Research approach had on the implementation of the activity was clear. The design benefitted from immediate feedback from participants which resulted in relatively quick and straight forward amendments to improve the games-based activity. It is far easier to do this as part of the design than developing fully and having to backtrack and as such the approach developed here is user-centred. There was a large gap in some cases in the researcher's predictions as to how participants would behave compared to how they actually behaved. In the second game space, set within the Italian Gardens, groups did not respond as anticipated and it was the feedback from groups that led to an iterated puzzle design that fully met the brief of this study. Similarly, the final game space on the roof of the Performance Centre changed significantly based on participant feedback, and the activity was more robust and fit for purpose as a result. Whilst the process may not have been a truly participatory design in the sense that the final design choices were still made by the researcher, the iterative nature and participant feedback was key to the evolution of the puzzles and the final product.

The process of implementing this locative games-based activity on campus has both been challenging and insightful. Barriers that hadn't been considered fully, such as the inability to be able to include the activity in a credit bearing context, had significant knock-on effects, such as recruitment of students and the commitment to participate from those who came forwards. As a result, the data sets collected have been small yet the experience of putting the design through an iterative process has still provided the opportunity to test the framework that underpinned the design of the activity and the methodology's supporting its implementation.

Additionally, the problems encountered have been primarily practical ones of weather conditions and university policy, as opposed to fundamental theoretical ones where the games-based activity or its design principles have failed.

Challenges that surfaced around technology and software were easily dealt with. In the instance of Google removing the Chrome browser physical web extension a fall-back option, despite being frustrating, was available. As with all educational activities utilising technology, whether that's a lecture presentation, marking and assessment or a games-based activity, a back-up plan is essential! Where amendments were required to be made to code, the researcher was able to implement these without assistance.

The response from students towards the activity was in all cases positive. There was plenty of constructive criticism which drove the iterative process and the engagement from those that took part was strong. Those who had participated in one of the iterations encouraged others to volunteer and were vocal in expressing their support and positive experiences to others.

From a practical stance the implementation of the games-based activity and iterative process was a success. It is in the following chapter that an evaluation of the effectiveness of the activity in terms of the impact on learning and collaboration takes place, and, in addition, an evaluation of the iterative process and the conceptual framework.

7 Evaluating effectiveness

This chapter will evaluate the effectiveness of both the games-based activity and the conceptual framework that underpinned its development. As discussed in Chapter Two, the Contextual Review, evaluating the effectiveness of educational interventions is widely acknowledged as a difficult task. Frequently data demonstrating sustained engagement is recorded and success of an activity is based on student perceptions of how useful or enjoyable the exercise was. Rather than focusing purely on engagement, this study has always been centred on ensuring educational effectiveness and this is measured by evaluating the impact of the activity on learning outcomes. This evaluation will be achieved by examining the data gathered through observation of the activity, the Personal Meaning Maps completed by participants, and by looking at the resulting artefact created by each group. Discussion around how the activity impacted learning will consider to what extent learning outcomes were met, whether any unintended learning took place and, if learning outcomes were not achieved, why this might be.

This will be followed by a critique of the framework and methodologies that led the design of the experimental prototype. Evaluation will cover issues such as: whether the framework sufficiently supported the design process; whether consideration of the steps in the framework was apparent in the completed design; if the use of the framework has aided evaluation; whether the specified tools and methodologies (Learning Mechanic - Game Mechanic framework, Design-Based Research methodology etc.) were fit for purpose.

7.1 Evaluating effectiveness through observations

The researcher accompanied each group as an observer in order to monitor how participants interacted with the activity and each other. Observations were recorded through notes. This was because of the mobile locative nature of the game meant that sound recording was not possible. The researcher was particularly interested in how challenging situations were navigated by the group, where collaboration came easily and instances where collaboration was less forthcoming. It was hoped that observation would assist with identifying any issues around user

interface navigation, comprehension of questions and puzzles, along with how appropriate the challenge level was. From observing at a distance, the researcher would also be able to pick up on non-verbal signals and body language from the participants as they worked together. Any interaction with the groups was minimal, with the exception of Iteration One where the researcher was required to provide the puzzles in place of the beacons' broadcasting. The researcher observed from a distance so as not to be included as 'part of the team', and for the most part was able to be silently present in the background.

7.1.1 Use of technology

For the activity to progress well where participants focused on solving puzzles and working together, the user interface and interaction with the technology needed to be straightforward and easy to use.

Whilst physical interaction with the beacons themselves was a part of some puzzles, it was intended as far as possible to have an unobtrusive interaction design elsewhere. The vehicle for delivering the content was the participant's own mobile devices. As a result, it was observed that groups all felt confident navigating their way around the device and did not need instruction. The installation of an app was straight forward, and the app chosen for use for the experiment, along with the webpages that displayed the puzzles, did not require participants to amend or change any settings or to save as they progressed through the activity. Despite not being familiar with either Bluetooth beacons or the webpages requiring input for the answers, all groups appeared to engage and interact with these tools without issue.

The game spaces were aimed very much at getting groups to interact with the environment around them and each other, drawing participants away from the screen of the mobile device. Answers were not of the type that could be 'googled' and, again following the principle of unobtrusive technology, groups were not required to refer to the devices other than to receive instructions or input answers. In Groups One and Two the observer noted that participants used the screenshot

function on their devices to save the secret location clues and also recorded their journey using the camera on the device. The device that was intended primarily to deliver the game content, directions and receive answers, took on a secondary role for groups capturing information to refer back to alongside creating material to feed into their collaborative map.

7.1.2 Behaviours that facilitated collaboration

Throughout the activity the observer noted when groups were demonstrating behaviours that facilitated collaboration. Processes considered that could demonstrate collaboration included (but were not limited to), 'exchanging ideas, giving and receiving help from others, clarifying strategies, resolving conflict and encouraging others to participate' (Wilczenski et al. 2001: 270). The observer also intended to note any behaviours that detracted from the collaborative group process. For the purpose of the observation, the definition of 'improvisation' was influenced by Miner, Bassoff and Moorman (2001). There must be a 'degree of novelty' in the intended action; to expand on this, novelty is required in that the behaviours looked for are not based on pre-existing routines (unlikely given the nature of the games based activity), and *intended action* refers to deliberate, as opposed to accidental, outcomes.

The first opportunity for groups to work collaboratively occurred after the Personal Meaning Mapping but before embarking on Puzzle One. Groups were given the opportunity to discuss how they might record their journeys and collate material to create a map collaboratively. In each group planning and time management skills were observed with participant's all feeding into how and when the process would occur. Some participants were clearly improvising around how they might apply their own discipline's skills to the task in hand

'*I could make a representative 3D environment that you guys could superimpose your 2D work onto'* (Participant Two, Group One).

'*We could write some haikus as we play'* (Participant Three, Group Two).

The activation of conceptualisation and visualisation skills were also observed in the form of participants pitching their ideas to each other and putting others ideas into practice. This task resulted in participants starting the games-based activity in the mind set of being part of a group and approaching the task collectively.

Game space one

As groups moved to the first game space and received the puzzle, there was instantly discussion as to what it might mean. Communication and problem-solving skills were activated; the observer was focused on how effective communication was within the group and whether anyone took on a natural leadership role.

Group One were quite excited to be play-testing this activity and at first some of the group literally ran in different directions before a shout from one participant brought them to the correct spot. Once the beacon was found, communication between Group One became more effective, and they discussed what they thought that the riddle may mean, sharing suggestions and experimenting with different methods of interacting with the beacon. Group Two stayed as a group, exploring the game space together, finding the beacon as a group. This behavioural method appeared to generate a shared sense of achievement 'come on we can ace this!' (Participant Two said in an exuberant manner).

A participant in Group Three appeared to take on a leadership role early on, and this persisted throughout the games-based activity. The participant was clearly confident in their ability to communicate to others and did so effectively, at times enabling a quieter member of the group, providing space and opportunity for them to communicate using leading questions such as 'what do you think about this one [name]?'(Participant One, Group Three).

Each group handled the task of how to manipulate the physical beacon effectively. Coming together to improvise with singing to it, holding it in hands, putting under their shirts and covering with coats/clothing. The game space certainly enabled participants to partake in processes that demonstrated collaboration including exchanging ideas and encouraging others to participate. This required the use of problem-solving and improvisation skills in line with the intention of the design.

Game space two

As a result of student feedback, this puzzle was changed through the iterative process quite significantly and therefore the difference in observations of skills used and processes demonstrated between the groups also changed across the iterations. As discussed previously, in Iteration One the skills associated with good collaborative working were not triggered. It was observed that this was because the processes that could demonstrate collaboration were not facilitated. There was no reason for participants to need to work together to solve the cryptic clue and the challenge level was such that individuals became inward facing whilst resolving. After re-design, the group in the final iteration were observed to communicate much more effectively with each other: they now had separate roles and had to bring those together. The giving and receiving of help was observed to be that one person completed their task before the others and the clarification of strategies when the puzzle was initially presented to them. This puzzle was not initially effective at requiring the use of collaborative skills (intended to be problem solving, communication, organisation, investigation, visualisation), however due to the iterative process this was rectified.

Game space three

The walk to this game space was fairly long and it was observed that all groups used this opportunity to discuss how they were recording their journey and what form the final map may take. For example, a Participant One of Group Two said, 'maybe we could use the photos and screenshots in a montage' and Participant Five of Group One said, 'it's a large physical area, we could make stuff about the, like, emotional journey instead?' It was at this point that the observer noted in all groups the act of working together to solve the puzzles in each game space appeared to produce a sense of 'we are in this together'. Comments became more markedly about 'we' rather than 'I' (example, 'I wonder if I could …' became 'maybe if we…'. The communications heard when moving between games spaces reflected this, with groups walking more closely together as well as using the opportunity for group discussion as the activity progressed.

Once in the correct location, all groups demonstrated collaborative problem solving, and communication skills. However, in particular, the puzzle here encouraged improvisation. In line with the definition of 'improvisation' that the observer was following, there were clear examples of the groups agreeing on an intended outcome (i.e. warming the beacon) and identifying a course of action that was not based on any pre-existing routine. Whilst the outcome may not have been successful for all groups, the behaviours exhibited still allowed the skills for effective collaboration to be practised.

Game space four

The puzzle presented to groups in this game space proved quite challenging. In order to solve this puzzle there needed to be very clear communication, organisation and negotiation around roles. The observer was able to note two contrasting approaches to this puzzle. Group Two clearly demonstrated the behaviours and skills required to solve the problem. There was the active exchange of ideas as to how best remember the sequences that would be presented to them, a clear division of responsibility and negotiation around who would be best for each role. In contrast, Group Three quickly entered into the puzzle without much discussion, planning or negotiation. As a result, they did not complete it successfully. That is not to say that the experience of poor collaboration did not positively impact on learning outcomes. The group went on to reflect on this experience and amend their approach for the following game space.

Game space five

As with game space two, the challenge presented to groups differed significantly through the iterations. Group One did not communicate effectively with participants and they ran in different directions with no plan or role. The purpose of the group was vague in Iteration One and as a result the behaviours that facilitated collaboration were not required. There was little exchange of ideas and no clarifying of strategies, not through any fault of the group but through bad design of the game space. Successive iterations based on these observations meant that successful completion of the puzzle required clear communication, organisation and improvisation. At this point in the activity groups better understood the

importance of establishing roles and responsibilities, and how effective communication impacted on the success of their problem-solving. For example, Group Two referred back to their experience in the previous game space, 'right, this time lets read the instructions and figure out what we're doing before we start' …. 'are you sure you're ready'. This time the communication and organisation skills were far more effective. The group took more time to establish and clarify their roles; each query raised was discussed and each person in the group was active in the discussion.

Secret location

In the design process the inclusion and implementation of a secret 'bonus' location was carefully considered. This hidden location provided motivation for participants to strive to answer the questions rather than skip through using the help function. The clues needed to be at the correct challenge level, so that missing a single clue did not then result in achievement being impossible, only making it less likely. Observation showed that this tool worked as intended: groups were keen to discover the final location, spending longer on solving problems when stuck rather than skipping forward,

'come on, let's just click on the next one', (Participant One, Group Three).

'no, cause then we won't get the clue', (Participant Two, Group Three).

'oh yeah – OK'. (Participant One, Group Three).

Where groups failed to solve a puzzle and did not receive a clue to the secret location, they continued to attempt to collect the others as they were hopeful that they could still figure out the final location.

The perceived self-efficacy of participants undoubtedly impacted on performance in this collaborative group situation. Those who perceived themselves as being capable and having the pre-requisite skills for the challenge appeared more likely to instigate working towards a potential solution. Additionally, there are recurring themes in research that suggest 'stored knowledge and skills shape improvisation in important ways' (Miner, Bassoff and Moorman 2001: 304). For example, early on in

the activity one participant declared, 'this is like an escape room, you need to look everywhere …' (Participant Three, Group One).

As a result of using an iterative approach, the observer had recorded behaviours and development of skills, as outlined above, that demonstrated the final design of the activity would support participants in achieving learning outcomes one and two as set out in Chapter Five (p.110) of this thesis:

- LO1: Evaluate problem-solving strategies, and work as a team to implement them.
- LO2: Demonstrate the importance of effective communication and the advantages of being able to conceptualise your ideas, visualise others and improvise.

7.1.3 Suitability of observation as a method

Observation has been an effective method within this context. It allowed the researcher/observer to assess how the design was functioning practically as well as its success in encouraging groups to collaborate. It was as a direct result of some observations that significant amendments were made to future iterations and having the opportunity to identify issues at a prototype stage and address them was invaluable. Had the researcher instead depended on user feedback, participants would have been relied upon to report back the actions taken and obstacles encountered. This type of feedback would be unreliable when the students may not have been aware of some of the behaviours they exhibited or the intentions behind some of the design decisions.

Whilst observation of the group can provide an insight into the behaviours that facilitate collaboration and demonstrate effective collaborative working, care needs to be taken regarding whether the group success can be an indicator of an individual's achievement and learning. Therefore group work alone should only be used as the sole measure with caution. A more accurate method of identifying

individual achievement of learning outcome is through a pre and post activity assessment or activity, such as the Personal Meaning Maps.

7.2 In-game creative task

During the games-based activity the groups were asked to consider how they might 'map' their journey and experiences. This was presented before the activity started and groups were provided with the time to discuss how they might record their experiences and in what format they might like to present their map at the end. It was stressed to groups that the output did not need to be a map in the sense of a cartographical map, but simply a representation of the activity created using the combination of skills and disciplines between them. It was also made clear that the format could be digital or paper-based, with or without written contributions.

The task ensured that from the start of the games-based activity the participants were aware of the disciplines each group member practised within and opportunity had been provided to discuss their practice and how it might be incorporated into the creative task.

As groups worked their way around campus participants recorded their experience in different ways. The most common method was to take photos using the mobile phone that was also in use to locate the beacons. The mobile devices were also used to record sound and for note-taking. Some group members made sketches in notebooks as they moved from game space to game space or wrote prose and poetry. The researcher observed that discussions about the creative task tended to happen between game spaces during the walk, with group members often pointing out different elements of the experience of solving the puzzle to focus on.

On returning to the base room after completing the game, groups started to bring their work together. Groups had access to laptops, paper and art supplies. Despite each group having multi-media content and having discussed ambitious ways of combining their skills (as noted earlier in this chapter), they all defaulted to the ultimate output being based on text, photos and sketches. It appeared that

agreeing on a suitable platform on which to combine audio, photographic and text-based content was problematic. The university's own institutional virtual learning environment did not include a portfolio or repository tool that enables this kind of multi-discipline work to be presented. External platforms were excluded by participants due to the time constraints of setting up a suitable environment within which to amalgamate the content.

Each group produced a collaborative map of their experience thereby meeting the learning outcome associated with this activity which stated they would be able to 'create an artefact through inter-disciplinary collaboration with others' (learning outcome three). The motivation behind this creative task was not so much concerned with the final artefact produced, but the process of creating it. The focus was to include a task that required students to collaborate, drawing on the experiences and skills developed in the rest of the activity. In particular it was hoped that the skills identified for collaboration in the Creative Arts, visualisation, improvisation and conceptualisation would be utilised.

It was acknowledged by participants, without prompting by the researcher/observer, that opportunities to collaborate with other students outside of their course were rare, if non-existent.

> 'unless someone's your housemate or something, we don't really do stuff with people from other courses. I think we might work with film sometime soon?' (Participant Two, Group One).

> 'I wish we got to work more with other courses…' (Participant Three, Group Two)

Within the context of this study the scope of the task itself was necessarily small. Time and resources were constrained, there was little motivation for participants to continue the collaboration outside of the framework of the exercise. Yet, the desire to create something more involved was expressed.

7.2.1 Collaborative maps

Group One had collected photos, notes, leaves and a sound recording from within the walled garden. Initially the group had been discussing the possibility of creating a 3D platform game representing the journey, however it was quickly apparent that this was too ambitious for the task at hand. It was agreed that a digital map be drawn up comprising of the materials collected and the group negotiated who would be responsible for each element, basing it on individual disciplines and expertise. The process of conceptualisation, or pitching ideas, was exhibited by every member of the group as participants shared their suggestions and contribute to the design. The group decided to focus on representing textures within their design, the images collected by one participant (the game artist) were often macro shots of the environment within each game space. The team successfully negotiated different roles, from digital asset creation, to digitising the physical objects and writing a narrative that represented their journey.

Figure 7-1: Excerpt of the map produced by Group One. The image was constructed from textures that represented each area alongside narrative that conveyed their journey.

Group Two used a combination of digital and paper-based techniques to create their map. They had collected images, but the two artists stated they preferred to sketch / draw on the map. The creative writing student had been making notes

whilst walking around the campus and worked on creating a piece of writing to represent each game space. The group did not want to create a classic map representation and agreed on the idea of aging the map. There was a good demonstration of visualisation skills the group listened to one of the artists who was explaining an idea about highlighting sketches with a lighter background colour. The conversations back and forwards showed a constant flow between the processes of conceptualisation and visualisation. Again there were suggestions and a desire to work on something more complex, in this case it was creating a series of aged images for each game space with prose linking each one with a narrative. The final piece was almost an early developmental piece of what could have been a much more extensive body of work.

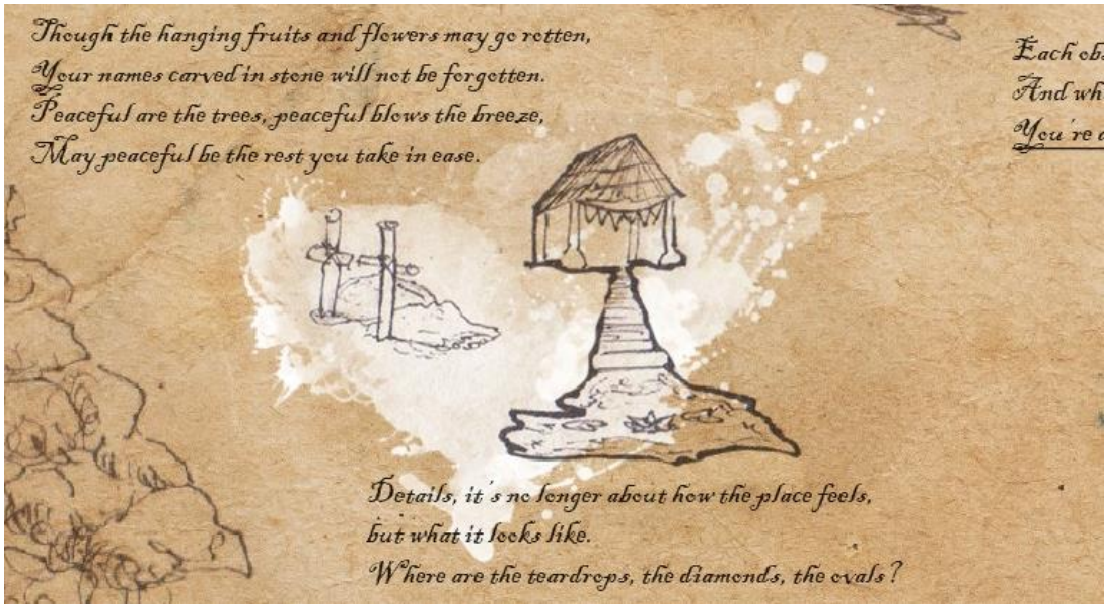

Figure 7-2: Small section of the map produced by Group Two. This part represented Game Space Two, the Italian Gardens.

Group Three had a different approach to the previous two teams and created a piece that allowed each of them to represent their own experience. They talked about wanting to bring those three separate experiences together on paper. The animation student did not feel they were able to create an animation in the time available, however decided to represent movement in their drawing. Each member drew around their hand and in-filled these with sketches based on photos they had taken and discussions about the experience.

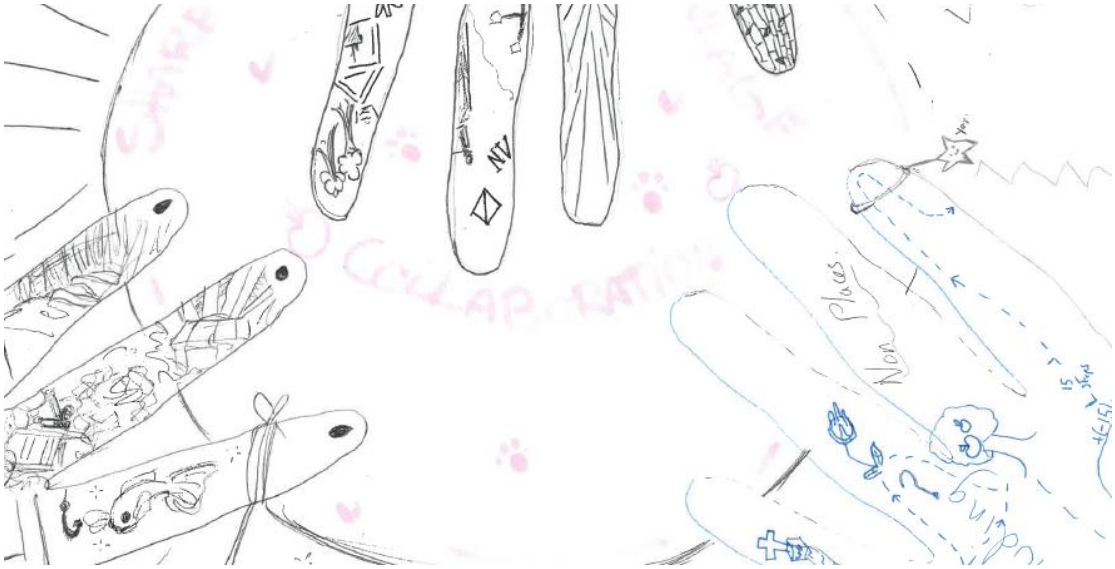

Figure 7-3: Section of map produced by Group Three. Showing the centre of the map as all three of their hands come together.

Each group by the very nature of this task demonstrated improvisation, in being able to bring together their different skills to create a singular piece of work, to a brief that a couple of hours earlier they were unaware of. They did not have their usual resources and tools at hand and needed to create something collaboratively with people they did not normally work together with. The completed map from each group can be found in Appendix six.

This study demonstrates that these students recognised the benefits of, and had an appetite for, interdisciplinary collaboration. If this games-based activity were part of a wider credit-bearing module, the additional time and motivation could encourage greater exploration of the collaborative creative process, whilst also being of value in terms of preparing students for industry or professional practice.

The inclusion of this activity in a credit bearing module would also be likely to impact on the methods of evaluation used. This study measures how each individual's understanding of collaboration and the skills required were affected by the activity. Should this activity be part of a wider module then it may be assessment methods are required to be introduced that consider the process of collaboration. As Orr (2010: 311) observed 'students' approaches to group work projects are, in part, constructed by the assessment tools employed'. Students may

feel threatened by the assessment methods in use, they can feel in competition with each other which could result in less constructive behaviour for collaboration. The participants in this activity were aware that the Personal Meaning Maps were the only method of evaluation other than observation and since the activity was not credit bearing there was no fear that observation of the process was going to adversely affect their outcome.

7.3 Evaluating the use of Personal Meaning Maps

Where the observation of groups allowed the researcher to assess the success and ability of groups to interact and collaborate with each other, the Personal Meaning Maps provided an opportunity to evaluate individual progress as a result of participating in a group collaboration.

After reading the information sheet and signing a consent form, each participant was asked to complete a Personal Meaning Map before commencing the games-based activity. Individuals were asked if they were familiar with the concept of Personal Meaning Mapping, which none of them were. However, each individual was familiar with the process of brainstorming on a piece of paper. The researcher requested participants to write the word 'Collaboration' in the centre of a piece of A3 paper and then brainstorm all of the words, experiences, thoughts they come up with related to that word. On reflection the researcher would write the desired word 'Collaboration' on the whiteboard as one individual wrote 'Collaborative' instead, which whilst not dis-similar, it would be preferable if the origin word was the same across all Personal Meaning Maps.

Participants were allowed as much time as they needed to complete their map. All participants came to a natural finish within ten minutes. In Iterations One and Two, there was no input from the researcher until participants indicated they had finished. The process was revisited at the end of the activity with groups being invited to add to their maps, again with no input from the researcher. Despite instructing participants to elaborate on their ideas and concepts, around 50% of the

meaning maps were quite flat, in that they represented a more traditional 'brainstorm'.

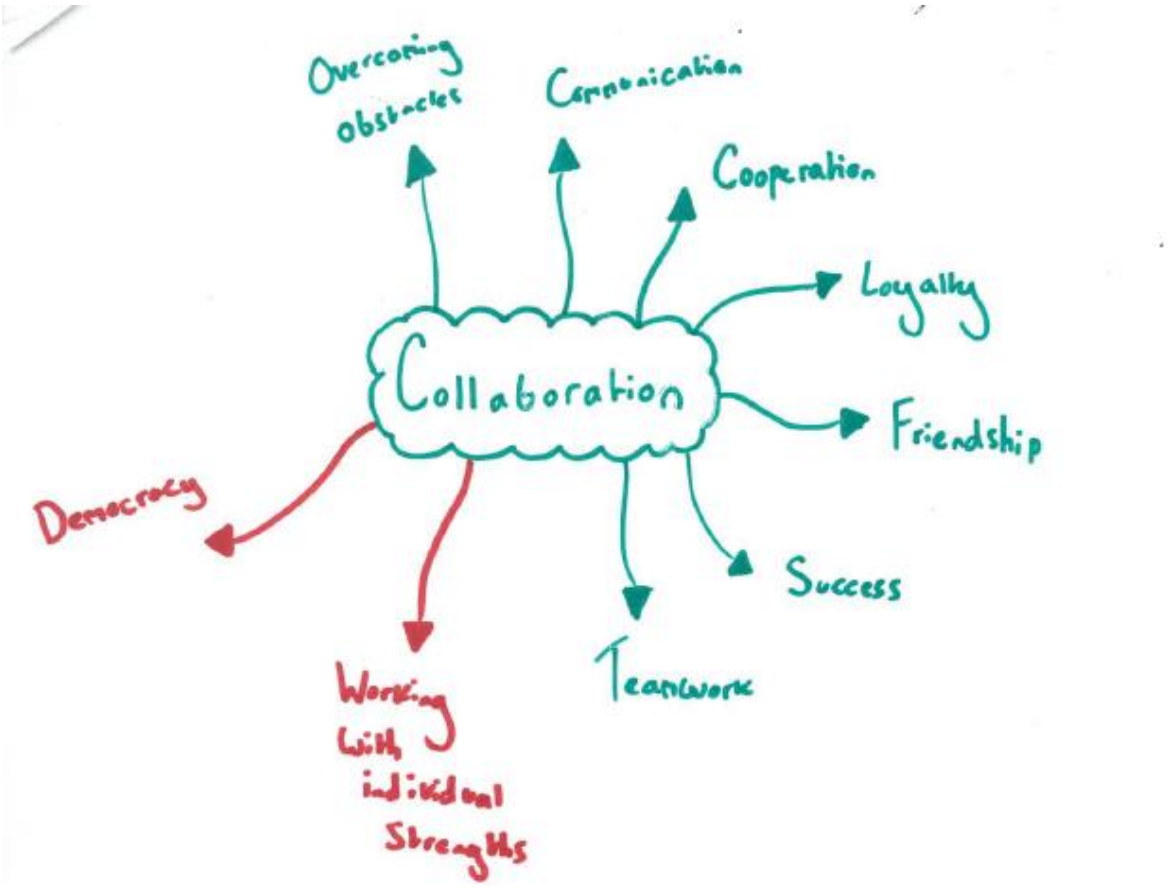

Figure 7-4: Example of a 'flat' Personal Meaning Map. Participant One, Group One.

In Iteration Three, the researcher prompted individuals to branch out with more detail on their maps, questioning if they had 'finished' or whether they could expand on their thoughts. No guidance was provided as to which entries on their maps should be expanded on, and it was not mandatory; if the participant felt they had finished the researcher did not request additional contributions to the map. As a result of the facilitation the personal meaning maps from Group Three were far more detailed.

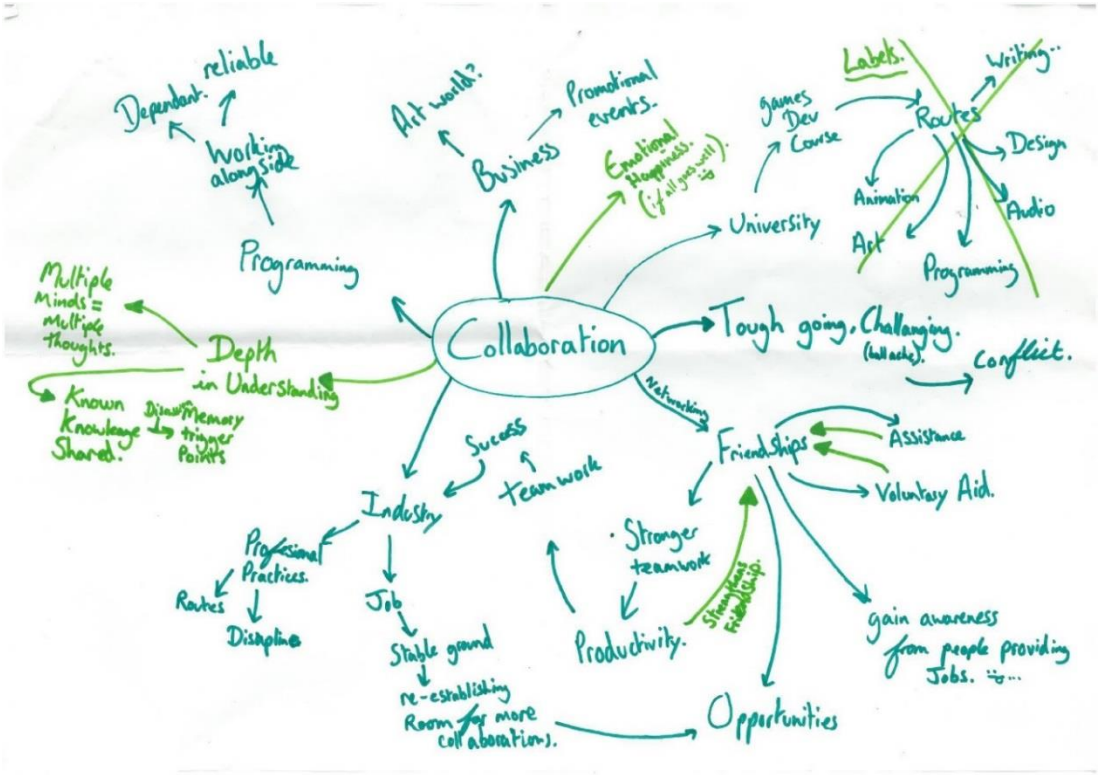

Figure 7-5: Example of a completed Personal Meaning Map from the activity (Participant two from Group three).

7.3.1 Analysis of Personal Meaning Maps

As outlined in Chapter Three, Research Design (p.67), the Personal Meaning Maps are analysed through scoring on four semi-independent dimensions: Extent, Breadth, Depth and Mastery.

Dimension one - *extent,* was scored by counting the quantity of relevant words/phrases associated with the term collaboration. This score enabled the researcher to consider the extent of a learner's knowledge; how much they know about the idea of collaboration beforehand and whether partaking in the activity change this. The researcher included words related to activities, experiences or skills involving or referencing collaboration. These included words such as 'teamwork', 'communication', 'cooperation'. Words that were very generic in their meaning such as 'film', 'business', or 'technology' were excluded unless part of a phrase that directly related to the idea of collaboration.

Participant	Before activity	After activity	Difference
G1:1	8	11	3
G1:2	9	11	2
G1:3	18	23	5
G1:4	14	20	6
G1:5	6	8	2
G2:1	4	10	6
G2:2	4	8	4
G2:3	9	16	7
G3:1	11	16	5
G3:2	14	20	6
G3:3	11	18	7
		Total Average	4.8

Table 7-1: The scoring for Dimension One: *Extent*.

In all cases participants recorded an increase in the number of relevant terms added to their Personal Meaning Map. The additional contributions ranged from a minimum of two entries to a maximum of seven, with 4.8 being the average increase in relevant terms across all personal meaning maps. Of particular interest is that the group average increased through each iteration, (group one = 3.6; group two = 5.6; group three = 6), showing participants were increasingly able to contribute more to their Personal Meaning Maps post-activity as the iterations progressed.

Dimension two: *Breadth.* This was scored by identifying where participants have formulated their ideas into a concept and by measuring the 'change in the quantity of different conceptual categories' (Falks, Moussouri and Coulson 1998:6) from pre- and post-activity. The researcher compiled an index of the conceptual categories that could be identified across the Personal Meaning Maps which could inform scoring this dimension. These are outlined below with examples of the types of words or phrases that were assigned to these categories. Categories were coded for ease of use during the analysis.

C1: Challenge (e.g., Problem-solving, hard work).

C2: Communication (e.g., skills required for or importance of).

C3: Compromise (e.g., ability to or importance of).

E1: Emotional engagement (e.g., exciting, frustrating, anxiety).

G1: Group failure or success (e.g., shared goals, all win or all fail).

P1: Practical applications (e.g. required in industry / in University).

S1: Shared learning (e.g., learning from each other).

S2: Sharing of ideas (e.g., shared creative endeavour, different ways of thinking).

S3: Social relationships (e.g., trust, loyalty, friendship).

S4: Subject matter (being particularly useful to a field of study).

T1: Teamwork (e.g., bringing together a pool of different skills, group roles).

W1: Weaknesses / Strengths (e.g., awareness of, working with).

Conceptual categories were identified by grouping related terms across the Personal Meaning Maps into concepts. Unlike concept mapping these categories were not predetermined but drawn from participants own interpretations of collaboration and the themes that encompasses.

In all cases participants recorded an increase in the number of concepts added to their personal meaning map (see table 7-2).

Participant	Concepts identified before activity	Concepts identified after activity	Difference
G1:1	5	7	2
G1:2	3	4	1
G1:3	6	8	2
G1:4	4	7	3
G1:5	4	6	2
G2:1	2	7	5
G2:2	2	5	3
G2:3	4	6	2
G3:1	4	7	3
G3:2	5	7	2
G3:3	5	8	3
		Average	2.5

Table 7-2: The scoring for Dimension Two: *Breadth*

The additional contributions range from a minimum of one to a maximum of five, with 2.5 being the average increase, post-activity, in conceptual categories across all Personal Meaning Maps. The categories of teamwork and communication increased most frequently across all the maps.

Dimension Three: *Depth* considers the complexity and detail of the Personal Meaning Maps, the *depth* of knowledge. As an example, if a participant included the word 'communication', did they also include the various different types of communication that may be required? How to communicate effectively? What constitutes bad communication? Or maybe they would have elaborated on why communication was so important. Analysing the depth of a Personal Meaning Map can provide insight as to the specific areas of a subject that the participant may have knowledge and experience in. In line with the method of scoring set out by Falks, Moussouri and Coulson (1998), scoring was based on a scale of 1-4 (1 = no elaboration and 4 = significant elaboration). Webb et al. (2005) devised a rubric for scoring this dimension which has been used in this analysis. Table 7-3 outlines how the scores of 1-4 are awarded based on depth of knowledge.

Level	Learner's actions	Key actions
Level 1: *Recall*	Requires the recall of information, such as fact, definition, term or a simple procedure.	List, Tell, Define, Classify, Identify, Name, State, Write, Place
Level 2: *Concept*	Involves mental skills, concept or processing beyond reproducing a response.	Estimate, Compare, Organise, Interpret, Modify, Make Predictions, Establish Cause / Effect Relations, Summarise
Level 3: *Strategic Thinking*	Requires reasoning, planning, using evidence, and a higher level of thinking.	Criticise, Formulate, Speculate, Build, Review, Investigate, Differentiate, Compare
Level 4: *Extended Thinking*	Requires complex reasoning, experimental design and planning, development and thinking. Cognitive effort is more demanding, and learners have to make connections within and among the domains of the subjects.	Design, Connect, Synthesis, Apply, Criticise, Analyse, Create, Try.

Table 7-3: Learners' depth of knowledge (Webb et al., 2005)

Participants in Groups One and Two did not go into a lot of detail when compiling their Personal Meaning Maps. The researcher had provided instruction at the start of the session but then did not intervene in the process and allowed individuals to decide when they had 'finished'. In Iteration Three, to facilitate more complete mapping, the researcher prompted individuals to branch out with more detail on their maps. This additional guidance resulted in more detailed maps and perhaps supported individuals to move away from what they perceived as an exercise in brainstorming to an examination of their own knowledge and experience. The researcher would recommend this facilitated version of Personal Meaning Mapping in order to more effectively explore prior knowledge of individuals and therefore aid evaluation of impact on learning.

The simplistic brainstorming approach adopted by about 50% of participants, despite being instructed to elaborate on ideas, led to some very flat meaning maps.

This excerpt demonstrates level one: The individual has recalled some words they associate with 'Collaboration' however, there is no further elaboration.

Figure 7-6: Depth of knowledge level 1, Participant Five, Group One

However, this was not the case in all Personal Meaning Maps. The example in Figure 7-7 from Participant Three in Group Two, provides an insight into how Dimension Three was scored. The individual started with the thought '*Anxieties*' and was able to expand on the idea considering why this anxiety may be present, how it might present itself and what needed to be done to combat it. This was scored at level three for depth of knowledge. If the individual had considered how the anxious behaviour may have impacted on the group or how the group may have responded to it the score could have been increased to level four.

This excerpt demonstrates level 3: Having defined the source of potential anxiety the individual is speculating what the thinking behind the anxiety may be and has identified areas to build on.

Figure 7-7: Personal Meaning Map demonstrating depth within a concept. (Participant three from Group Two).

With the intervention in Iteration Three by the researcher, as outlined above, the Personal Meaning Maps were more detailed and tended to demonstrate more depth of knowledge within concepts. In the example shown below (Figure 7-8) we begin to see an awareness of cause and effect and perhaps cyclical relationships being demonstrated (aligning with level two in the scoring of this dimension).

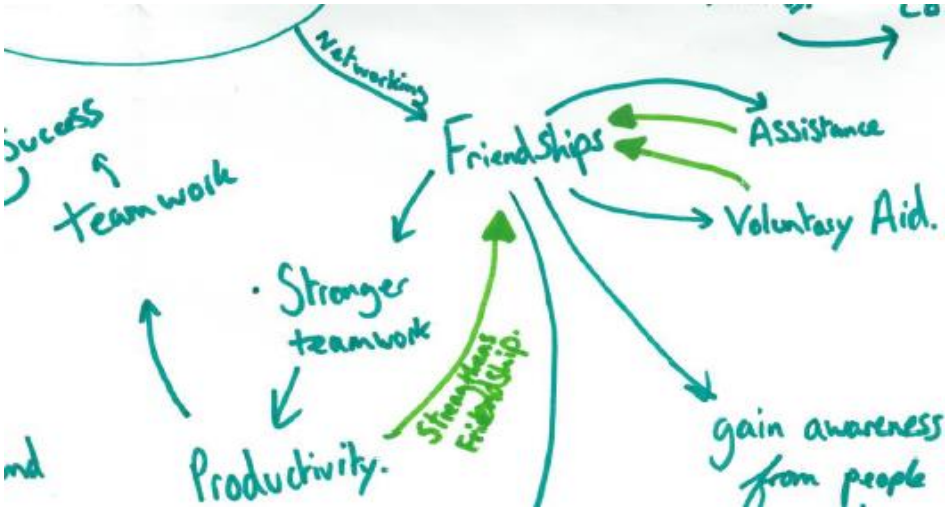

Figure 7-8: Demonstrating awareness of cause and effect. (Participant Two from Group Three).

36% of the Personal Meaning Maps scored the minimum of one for demonstrating depth of knowledge. They were 'flat' meaning maps with primarily single word contributions. The remaining meaning maps all scored up to two for dimension three, with one meaning map scoring a depth score of three, as shown above (Figure 7-8). In the majority of the Personal Meaning Maps there was no significant change shown along dimension three from pre and post activity mapping.

Dimension four: *Mastery*. Considers how complete the map is in a holistic way. The scoring focuses on where on the scale between novice and expert the participant may be. The following four levels of mastery can be scored: (Harber 2014)

- Level 1 – Simple, novice-like understanding.
- Level 2 – Intermediate level of understanding.
- Level 3 – Proficient level of understanding.
- Level 4 – Highly detailed, expert-like understanding.

Characteristics to consider (as well as the previous dimensions) include the quality of the connections; the number of lines connecting ideas and thoughts on the map. For example, one point may be given for each legitimate link between areas on the map. In some cases, scores can be calculated by subtracting the number of irrelevant or inaccurate items from the number of appropriate contributions.

In the first instance the number of lines connecting relevant ideas and thoughts were counted. Table 7-4 shows the number of links drawn between relevant words or phrases pre and post-activity.

Participant	Legitimate connecting links pre-activity	Legitimate connecting links post-activity	Increase post-activity
G1:1	0	0	0
G1:2	3	3	0
G1:3	8	8	0
G1:4	5	6	1
G1:5	0	0	0
G2:1	0	0	0
G2:2	0	0	0
G2:3	3	4	1
G3:1	0	5	5
G3:2	8	11	3
G3:3	9	16	7

Table 7-4: Shows number of legitimate connecting links on PMM pre and post activity.

The table highlights that the participants from Group Three contributed far more connecting links across their meaning maps than previous groups.

The links however only demonstrate that an individual connected items on the meaning map and gives no indication of the depth or breadth of the connected words or phrases. In order to establish level of mastery this was then looked at in the context of the scores from Dimensions One, Two and Three.

The score that each participant received for each dimension was totalled once for pre-activity and again for post-activity, allowing for a quantitative comparison. As Table 7-5 shows, the average increase in relevant additions to the Personal Meaning Maps post-activity was notably higher in each group than the preceding

one. A complete breakdown of the scoring for each dimension across each participant can be found in Appendix five.

Participant	Total dimensions scored pre-activity	Total dimensions scored post-activity	Difference
G1:1	14	19	5
G1:2	16	20	4
G1:3	34	41	7
G1:4	25	35	10
G1:5	11	15	4
G2:1	7	18	11
G2:2	7	14	7
G2:3	19	29	10
G3:1	16	30	14
G3:2	29	40	11
G3:3	27	44	17

Table 7-5: Showing pre and post activity total dimension scores

Whilst it should be acknowledged that those in Iteration Three were provided with a prompt to provide more to their personal meaning map should they want to, this additional prompt occurred both pre and post activity. As expected, the total number of relevant terms, links and ideas was much higher in Group Three's Personal Meaning Maps. However, looking at the *difference* between the pre- and post-activity, it is clear that Group Three contributed to their Personal Meaning Maps in a more extensive and meaningful way post-activity than the other groups.

All but one of the Personal Meaning Maps within the study were scored at either level one or level two of mastery. In order to have achieved a proficient level of understanding as opposed to intermediate the researcher would need to have seen increased demonstration of depth to the concepts identified. This outcome is unsurprising when considering the participants are undergraduate students who have not been undertaking any study specifically related to the subject of collaboration. In addition, the purpose of the activity is to introduce and enhance the practice and knowledge of collaboration, in anticipation of students having at a novice-like understanding of the concept. The researcher would not have expected

the students to become fully informed and proficient in collaboration after just one activity.

In this study the Personal Meaning Maps provided an insight into the impact the activity had on the specified learning outcomes:

LO1: Evaluate problem-solving strategies, and work as a team to implement them.

LO2: Demonstrate the importance of effective communication and the advantages of being able to conceptualise your ideas, visualise others and improvise.

There were many instances where an individual had elaborated on teamwork, problem solving strategies and effective communication post-activity. As a direct result of the participants experiences during the activity, there was demonstrably greater understanding of these concepts relating to collaboration. In particular, there was recognition from participants in each group of how to start working effectively as part of an interdisciplinary group. The following excerpts are a selection from the personal meaning maps that captured the individual reflecting on working with others throughout the challenges. They were all written post-activity.

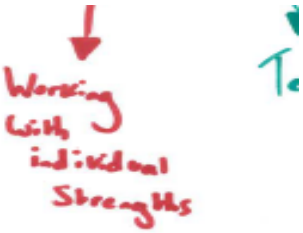

Figure 7-9: Working with others, Group One, Participant One

Figure 7-10: Working with others Group Two, Participant Three

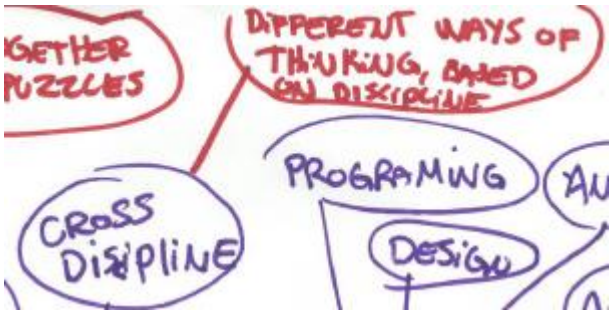

Figure 7-11: Working with others Group Three, Participant One

Figure 7-12: Working with others Group Three, Participant Three

The majority of the Personal Meaning Maps included some reflection on the skills or considerations required for effective interdisciplinary working.

Overall the Personal Meaning Maps provided evidence that learning had taken place as demonstrated by clear change along three of the dimensions. Only one of the dimensions of learning, dimension three, *depth*, was not shown to experience significant change. Taking into considerations the scores across the other dimensions, this demonstrates that new concepts may have been introduced and participants started to consider collaboration in new ways, however they did not develop a rich understanding of those concepts. The researcher concludes that this type of games-based activity would benefit from being followed up by consolidation work in the form of a group discussion, supported by the lecturer. This would help put the activity into context and consolidated what the participants have learned about collaboration through the experience. Such an approach would assist with increasing the depth of knowledge and capitalise on the activity.

7.3.2 Considerations when using Personal Meaning Maps

There were some challenges encountered using this method; primarily, balancing the benefit of taking a semi-structured interview approach, facilitating individuals to complete their Personal Meaning Maps versus allowing the learner complete autonomy and providing only introductory instructions and guidance. The consequence of allowing a fully autonomous approach meant that perhaps the Personal Meaning Maps were not as detailed and therefore fully representative as they could have been. Whilst Personal Meaning Mapping has been likened to brainstorming, and participants were familiar with this technique, the researcher would recommend an example of a Personal Meaning Map is shared before the exercise begins. The example Personal Meaning Map should relate to a different subject so as not to influence participants own contributions, however a demonstration of the level of detail that may be possible and acceptable formats would potentially provide the confidence and awareness participants would require to enable them to complete their own as fully as is possible.

There would be merit in further research to understand to what extent the act of completing a Personal Meaning Map result in changes in participants' thinking. By completing the exercise prior to the activity, the individual would have a grasp of the concept of collaboration and we might ask what that might lead to if it were at the forefront of their mind. The very act of completing a Personal Meaning Map could mean they engage in behaviours more suited to effective collaboration, because they have had time to consider what that means beforehand and in this case it would frame their behaviour more cogently.

The overall effectiveness and appropriateness of using Personal Meaning Maps in this context has been validated. The use of this method provided an insight to an individual's experience and learning in a group interdisciplinary activity. Additionally, the meaning maps supported the use of the iterative approach taken with the design of the activity. Those in Iteration Three were able to contribute significantly more to their meaning maps than previous participants, which, given the changes in each iteration to support the development of the skills required for collaboration, was a welcome outcome. For future iterations or similar games-

based activities using this method of evaluation, the findings suggest that a facilitated approach results in richer meaning maps and therefore students may benefit from using these enriched meaning maps as a prompt for deeper discussion later in a module or course.

It should be noted that whilst the Personal Meaning Maps were only revisited once in this study, if used in a wider context such as a module, the meaning maps can be returned to time and again to demonstrate improved understanding and knowledge of a subject area.

7.4 Effectiveness of conceptual framework and associated methodologies

The design of this study, from the games-based activity itself to the way in which data was collected and impact on learning assessed, was led by the conceptual framework as laid out in Chapter Four and underpinned by a Design-Based Research methodology. This chapter now proceeds to evaluate the effectiveness of the conceptual framework and chosen methodology and whether they were fit for purpose.

The conceptual framework was created in response to there being a lack of guidance around the creation of pedagogically sound games-based activities. Specifically, this framework drew attention to the learning outcomes and the chosen game mechanics, the way that data would be collected and how it would be analysed. Finally, it appreciated that Creative Arts students may want to continue collaborations and have access to the work produced in an activity for subsequent work. Based on a review of the relevant literature, the conceptual framework was grounded in theory and designed to be practical.

As Chapter Five, Design of the Experimental Prototype shows, the framework guided the researchers own design process and method. It forced a thoughtful approach, any assumed expectations of what type of activity would be designed needed by necessity to be put to one side and constantly assessed and amended against the questions that the framework was raising. The first stage in the design

process was not thinking about what type of game the study should be based around, but *what the learning outcomes should be.* The framework not only supported this theoretically but practically. The visual design of the framework is in line with the natural approach to reading in English, from left to right. The very first concept the reader is introduced to is that of the pedagogic approach, and learning outcomes required of the activity. Only once these have been identified, does the framework then lead to consideration of what the activity might look like. Whilst the contextual review highlights the importance of identifying learning outcomes, the researcher found it is almost a natural instinct to instead focus on thinking about the type of activity first; the framework effectively focused attention on the learning in the first instance.

The researcher found that by being directed to consider pedagogical approach, skills outcome and the subject area of participants, significant time and attention was given to learning theory, particularly around Bloom's orders of thinking and how an active model of learning was going to be achieved. Following the framework resulted in not just identifying learning outcomes, but also ensuring they were appropriate and meaningful for the students. Starting to think about the game element of the activity, building from a foundation of relevant, SMART learning outcomes, meant *the pedagogic intention was robust*. The researcher found from this point forwards she was designing to meet learning outcomes and every design choice was looked at in that context.

When embarking on designing the games-based element for the activity the framework once again prompted thoughtful design choices. The framework guided the researcher to think about what *type* of games would promote the behaviour and development of skills required, which then led to an investigation of the game mechanics that this type of game would include. This method resulted in meaningful mechanic selection; through being prompted to consider game type, the researcher/designer was required to investigate how various mechanics were implemented in different games types. This provided inspiration and guidance in assessing which game mechanics would be appropriate and would have an effective impact on the learning outcomes. As an inexperienced game designer, the researcher gained confidence from investigating existing game types and the

mechanics they employed. The puzzles and challenges in the game were all starting from a theoretically sound place, there was a logic behind their inclusion and each one could be justified against the learning outcomes (as shown in Table 5-3, Chapter 5, p.118).

Exploring the game characteristics of the activity was extremely valuable for understanding the essence of the game-like content and ensuring the benefits that can be found in fully developed games were being transferred to this *games-based* design. The danger of having the focus primarily on learning was that the game-like elements would suffer through poor understanding and therefore poor design choices. With the conceptual framework encouraging exploration of game characteristics, the researcher felt there was an assurance that the engaging elements of the game would not be overshadowed by the pedagogical requirements. Whitton's (2010) definition of characteristics provided a reliable reference point which ensured that the activity retained the core elements of a game whilst also fulfilling its pedagogic purpose. The discussion in the next chapter considers how the framework can not only guide but also signpost people to resources and tools to help at each point.

The framework recommends allowing participants to extract work created as part of the activity. This element was more challenging to adhere to than other areas, yet of importance given that students were being asked to create a collaborative piece of work. While it was effective in bringing concerns around student access to artefacts and ongoing collaboration to mind, it is difficult to meet this need when the platforms or institutional online tools are not available. It became apparent that the conceptual framework could not only be used as a tool to guide design but also can be used to support a call for institutional change. If it can be proved that tools such as collaborative portfolios are pedagogically sound requests, that they are justified in the learning cycle and have benefits to students in terms of autonomy, ongoing collaboration and employability, then senior management and budget holders are more likely to support their development.

Having identified the pedagogical elements and games-based elements of the activity the conceptual framework ensured that consideration was given to data

collection and analysis. By considering this element of the study at the activity design stage ensures that particular needs can be attended to, for example, the making the activity collaborative in nature. The assessment model needed to be able to assess the individual, and by determining that Personal Meaning Maps would be used, the researcher / designer was aware that a pre- and post-test opportunity for this would have to be incorporated. Reflecting on these areas at this stage also allowed for assessment points and data collection to be incorporated into the gameplay itself if desired – whilst this was not something that the researcher/designer implemented it ensured that due consideration was given.

Overall the conceptual framework provided a clear and thorough route through the design process. It ensured that no matter how tempting it was to skip a stage and implement pre-conceived ideas, each one had to be tested and justified against the considerations outlined in the framework. Having this roadmap certainly resulted in pedagogically sound decision making and as a result any part of the design can be justified in terms of its purpose and place in the design.

7.5 Effectiveness of Learning Mechanic-Game Mechanic mapping

Having worked through the conceptual framework, the next stage for the design process had been to construct a Learning Mechanic – Game Mechanic (LM-GM) map (Figure 5-2, Chapter Five, p.124). The implementation of the LM-GM framework was intended to ensure each element of gameplay could be mapped across to relevant learning outcomes, and that the actions and behaviours they might provoke could be considered. The process of creating this visual representation of the game required a detailed dissection and reassembly of the game design.

It was more of an undertaking than expected and immediately raised questions around the game design. For example, amendments were made in terms of when participants would be able to access advice. Originally participants were to be provided with instructions and advice only in the briefing, but on laying out a visual interpretation of the activity it was quickly clear that no guidance for participants

had been designed into the game space itself. Groups would be spending a significant amount of time in 'game-mode' and would be likely to require support at some point. As a result of this realisation additional guidance was designed into the activity interface where required. Additionally, drawing out the LM-GM map drew attention to how and when the process was enabling group discourse and provided moments for content creation. These behaviours had not been looked at in detail when choosing game mechanics and learning outcomes; it became essential that the researcher was aware when and where to look out for these interactions. After creating the LM-GM map it became readily apparent that learners were moving through Bloom's orders of thinking as the activity progressed, from activating processes from the lower orders of thinking, *remembering* and *understanding* during the initial Personal Meaning Mapping and group planning stages, then progressing to *applying* and *analysing* in the game spaces and finally to *evaluating* and *creating* during the final collaborative creative task.

Completing this exercise allowed the researcher to maintain a balance between gameplay and learning within the design of the activity. It was a 'belt and braces' type approach to ensure that game mechanics for inclusion were chosen for their potential to impact the learning outcomes. The visual relationship between the two fed into the understanding being developed as to how these mechanics were going to activate the skills and behaviours that the researcher desired participants to develop. The LM-GM map was the first embodiment of the games-based activity, it was the first time that the various elements making up the prototype could be envisaged in their interconnecting form. Having this visual reference made the activity feel more concrete and achievable, providing confidence to progress and move forwards.

As such it is without hesitation that the researcher felt the use of the LM-GM map was an effective tool in the design of this study. The benefits of being able to use the terminology for learning outcomes and game mechanics rather than prescribe to a set taxonomy meant that the map was eminently suitable for the context it was needed and would be for others working to different learning outcomes or even definitions of game mechanics. Indeed Arnab et al. (2012), the originators of the LM-GM map, appear to have subscribed to a different game mechanics

definition yet the principle of using the LM-GM map was still sound and beneficial to this study.

7.6 Effectiveness of Design-Based Research methodology

The decision to use a Design-Based Research methodology and therefore an iterative approach to design was fundamental to the development of the activity. Feedback from groups in Iteration One and Iteration Two would never have been implemented in such a straightforward manner had an iterative design model not been in place. Many changes were made that resulted in individual challenges or whole game elements working more effectively. Design-Based Research was effective as a socially responsible research approach: with stakeholder input there were opportunities to remove barriers to entry as they were identified and to incorporate feedback.

In order to fully understand why this methodology was so effective at underpinning the research in this particular context it is useful to refer back to the characteristics of Design-Based Research as set out by Wang and Hannafin (2005: 8).

Characteristics	*Explanations*
Pragmatic	• Design-based research refines both theory and practice. • The value of theory is appraised by the extent to which principles inform and improve practice
Grounded	• Design is theory-driven and grounded in relevant research, theory and practice. • Design is conducted in real-world settings and the design process is embedded in, and studied through, design-based research.
Interactive, iterative and flexible	• Designers are involved in the design processes and work together with participants. • Processes are iterative cycle of analysis, design, implementation, and redesign. • Initial plan is usually insufficiently detailed so that designers can make deliberate changes when necessary
Integrative	• Mixed research methods are used to maximize the credibility of ongoing research • Methods vary during different phases as new needs and issues emerge and the focus of the research evolves • Rigor is purposefully maintained and discipline applied appropriate to the development phase.
Contextual	• The research process, research findings, and change from the initial plan are documented. • Research results are connected with the design process and the setting. • The content and depth of generated design principles varies. • Guidance for applying generated principles is needed.

Table 7-6: Characteristics of Design-Based Research (Wang and Hannafin 2005: 8)

Adhering to these characteristics ensured the benefits of a Design-Based Research methodology were fully realised.

A pragmatic approach allowed the researcher to assess and select the most appropriate definitions and tools that would support this study. The LM-GM model as discussed earlier in this chapter is an example of this pragmatic outlook.

Grounded in relevant research each design choice can be justified using tools and techniques that have been either drawn from or developed through study of the

relevant literature around learning technology and games-based learning in higher education. Design of the games-based activity was conducted with a real-life setting recruiting current undergraduate students and testing was carried on campus. These elements have provided a robustness to the study and the design decisions that were made.

The interactive, iterative and flexible approach was closely adhered to. Using the Design-Based Research methodology encouraged participants to feedback honestly and constructively. Groups were aware that their feedback would inform future iterations; Group One (from the Games Academy, so familiar with the process of games testing) were very enthusiastic in offering suggestions that could improve the experience for others.

An integrative policy with regards to research methods allowed the researcher to draw on approaches and tools from across disciplines. The Personal Meaning Maps originate from studies related to education in museums, Schell's definition of game mechanics originated from his professional practice in the Games industry, and, the classification of game characteristics were sourced from Whitton's (2010) work regarding games-based learning in higher education. The Design-Based Research methodology encourages this integrative approach resulting in the most effective methods being chosen for the specific context.

Finally, the process was inherently contextual. Results and feedback from each iteration can be connected with each element of the design. The activity can easily be viewed holistically or equally; through the LM-GM map and the conceptual framework each element can be separated out and a granular view can be taken. Every element of the design process and decision making has been documented in detail, along with the reasoning behind any changes made within each iteration and the impact those changes had. Any recommendations or principles generated can be supported by guidance and documentation, again ensuring the outcomes can be received with confidence.

An ongoing benefit of taking this iterative approach is that the design of this games-based activity can also be expanded on outside of and beyond the scope of this

research. It is hoped that there will be opportunity for recommendations made in the concluding chapter of this thesis to be implemented in future iterations.

The main consideration for future iterations would be looking to incorporate the activity within a credit bearing module. The small impact on learning seen here would have the potential to be enhanced if the experiences and skills attained were then put into context through deeper seminar-based discussions with time to create a more involved piece of work. Evaluation through the use of Personal Meaning maps would enable a longitudinal approach to measuring impact on learning, with students revisiting their meaning maps at set times throughout the module.

In conclusion, the effectiveness of this games-based activity for enhancing interdisciplinary collaboration was proven. Whilst the sample size was small, and the games-based activity would therefore benefit from further testing on larger cohorts, the principle of aligning games mechanics with learning outcomes was successfully tested and built upon through the iterative process. The experimental prototype had an impact on learning outcomes aligned with enhancing interdisciplinary collaboration and demonstrated that games-based activities that are both effective and engaging can be designed for Creative Arts students.

The conceptual framework used to guide the design of this games-based activity functioned as intended, dictating that both pedagogic and game design principles were given sufficient attention. Whilst participants in the activity, students were guided through each of Bloom's levels of thinking with the skills they were asked to activate in each stage of the activity gradually progressing to higher levels of thinking. This was clearly demonstrated by visual representation laid out in the LM-GM map.

The conceptual framework also ensured that data collection and assessment were incorporated into the design of the activity rather than included as an afterthought meaning the methods used complemented each other and met the specific needs of the study. The choice of data collection methods, observation and Personal

Meaning Maps, allowed for both the group dynamics to be observed as well as the individual's learning to be evaluated. Through the iterative process the most effective way to facilitate the use of Personal Meaning Maps was identified and recommendations provided. Both methods were appropriate for this study's purpose.

8 Conclusions

This concluding chapter begins with an overview of the research questions and objectives, offering an evaluation of the extent to which the research has addressed them and outlining the projects principle contributions to knowledge. The challenges and unexpected outcomes of this study will be examined followed by recommendations as to how the methods and findings outlined in this thesis could be applied elsewhere. Areas of interest for further research are highlighted before going onto discuss the ongoing need for research in this area and whether the landscape has changed over the duration of the study. Finally this concluding chapter will explore what's on the horizon for games-based learning in the Creative Arts, how this research may be relevant to the new tools and technologies being developed and how changing modes of learning are influencing pedagogy.

8.1 Revisiting the aims and objectives of the research

In Chapter One this thesis set out two aims for the research, the first of which was to:

- Contribute to educational theory regarding game mechanics in digitally-enabled learning experiences by identifying how game mechanics can enhance collaborative learning among arts students in HE.

It was intended that this aim would be achieved by meeting multiple objectives; an assessment as to whether these objectives have been met now follows.

- Identifying examples of digital resources incorporating games-based learning (GBL) used in HE.

This thesis explored the current literature and outlined in Chapter Two various examples of games-based learning being used within higher education, with a particular focus on cases that supported collaborative learning. The chapter

considered both mainstream commercial games in use within higher education and those designed specifically for educational purposes. This review provided an understanding of the challenges and successes being experienced by others following a games-based approach. Recommendations from those studies were taken into account, with attempts to address these within the design of the activity presented here. For example, Voulgari and Komis (2008) recommended that games mechanics were needed not only to encourage and require interaction in order to complete problems and meet goals. The design of the game-based learning activity used within this study attempted to incorporate this recommendation; amendments were also made throughout the iterative process to ensure that the mechanics used were encouraging and required collaboration for participants to complete the puzzles. Whitton (2010) had made recommendations that pre- and post-activity testing would be more reliable than self-reported learning. This recommendation influenced the decision to incorporate the use of Personal Meaning Maps.

Interviews with both academics and learning technologists across Creative Arts institutions in the UK provided the research with insight into the personal experience, perceptions and expectations around the use of games-based learning in HE Creative Arts. Interviewees were also asked about any anecdotal evidence they had regarding the use of the games for learning in the Arts. The findings from these interviews demonstrated that not only is games-based learning far from mainstream in the Arts but every interviewee struggled to recall a single example to share. The themes generated from the interviews directly influenced the design of the experimental prototype and resulted in an activity that could address the concerns around the practical, pedagogical and technical implementation of digital games-based learning.

Peer reviewing for relevant publications and conferences exposed the researcher to literature at the forefront of this field of study. Despite not encountering examples of games-based learning in the Arts whilst reviewing articles over the period of this research, inspiration was taken from other contexts; the importance of taking a learning outcome focused approach was clear, as well as the need to use methods of assessment that could show impact on learning. The literature frequently

lamented the lack of empirical study and this study hoped to contribute to addressing this concern.

Examples of digital resources incorporating games-based learning were also discovered through attendance within each year of study at the annual Playful Learning conference and analysis of the papers and workshops delivered there was undertaken. As outlined in Chapter One, in terms of games-based learning in the Creative Arts, there were very few examples across the years and those that were presented all focused on Creative Writing. As with the literature, inspiration was taken from the workshops attended as there were many examples of digital resources in HE including elements of games-based learning.

The research undertaken demonstrated that there was an appetite for the use of games-based learning in higher education and that progress was being made in various subject areas but that use within the Creative Arts was few and far between. Where examples were uncovered they were mainly one-off experiments or extra-curricular add-ons as opposed to being integrated activities within curriculum. The outcome from identifying examples of digital resources incorporating games-based learning used in higher education was a stronger design that benefitted from the experiences of many who had shared their research with the playful learning community.

- The investigation of the pedagogy of collaborative learning theory and its influence on the design of digital resources.

The thesis presents an examination of the pedagogy of collaborative learning theory in Chapter Two, and went on to focus on collaborative pedagogy in the context of the Creative Arts. There was clear pedagogical justification for collaborative learning, time and again the literature demonstrated that working collaboratively encouraged creativity. Attention was given to how collaborative systems were being included within digital resources such as games, and it was clear that networked technologies and the social interaction they have enabled have resulted in increased opportunities for collaborative learning. The

foundational idea behind collaborative learning, that knowledge construction happens more effectively in a social context through interaction, has underpinned the entire design. The pedagogical design sought to emphasise an active, social learning experience for participants.

- The creation of a conceptual framework for the application of game mechanics to digital resources in the creative arts.

This objective was achieved. This study succeeded in designing a conceptual framework that could be used to guide and inform the creation of games-based activities in the Creative Arts. The framework drew upon the findings and observations from the contextual review and the work undertaken to meet the objectives above. It quickly became clear that whilst there were models to support the development of games-based activity, for example the Learning Mechanic-Game Mechanic (LM-GM) model (Arnab et al. 2012) or the 4DF model (de Freitas & Oliver 2006b), most presumed some prior knowledge of either games-based learning, games development or made the assumption that there was experience in creating pedagogically sound learning resources.

The conceptual framework presented in this thesis was designed to be accessible for academics and non-academics alike, to be a roadmap from activity proposal to evaluation. The framework assumes no prior knowledge but guides the individual to consider the various components that when combined would result in comprehensive design. The framework balanced the pedagogic need with the game requirements, and paid specific attention to the needs of Creative Arts students and how impact on learning would be assessed.

The second aim this thesis hoped to address was to:

- Identify how individual game mechanics impact on specific learning outcomes.

This aim was addressed by working towards two further objectives. The extent to which these have been met is addressed below.

- The characterisation of game mechanics; identifying specific mechanics that will support individual learning outcomes.

The conceptual framework presented in Chapter Four of this thesis requires that game mechanics are considered in the context of the game types they are often utilised in as well as the game characteristics of the activity being developed. This ensured that the appropriateness and purpose of the different mechanics were examined, including the behaviours they might trigger in participants.

Building on Table 4-2 (see p.87), Table 8-1 below outlines how specific mechanics used within the games-based activity supported individual learning outcomes.

Mechanic	**Description of relevance to collaborative, creative work**	**Link to learning outcome**
Player roles / party mechanic	Providing each participant with a specific role ensures an awareness of individual accountability as well as a sense of shared achievement once the task has been completed. Used in game spaces 2, 4 and 5	Supported LO1 which required students to evaluate problem-solving strategies, and work as a team to implement them.
Combo mechanic	Combining certain actions in a certain order provides the participants with a greater advantage than the same actions would out of sequence. A useful tool that can be used to aid inter-disciplinary collaboration and encourage students to consider how different elements of a collaboration come together. Used through the game spaces to enable groups to gain the secret clues for the bonus location.	Supported LO1, encouraging students to consider different problem solving strategies
Puzzle mechanic	A puzzle will usually have only one solution and method of solving it. It	Supporting LO1 (problem solving) and LO2

	will by definition not be obvious and will require creative thinking in which to find a solution. Used throughout each game space, but particularly during tasks that involved manipulating the beacons (game space 1 & 3) the memory game in game space 4.	highlighting the importance of effective communication and how an advantage can be gained by being able to communicate your ideas effectively
Time dependence / countdown mechanic	Participants must fulfil certain objective/s within a specific timeframe. This can be designed so that it is impractical or impossible for a single individual to meet a deadline, therefore requiring effective group work in order to complete the task successfully. This was used during the end task where groups were given a set time in which to produce a collaborative 'map' of their journey and experiences.	Supported LO3 which required students to create artefact through interdisciplinary collaboration.

Table 8-1: Examples of specific game mechanics linked to specific learning outcomes in the activity

Table 8-1 draws specific conclusions about mechanics and learning outcomes. For example, the party roles mechanic was implemented within some of the game spaces with the intention of triggering behaviours supporting collaboration and teamwork. This was due to the mechanic providing each participant with a specific role ensuring an awareness of individual accountability as well as a sense of shared achievement once the task had been completed. The tasks where this mechanic was implemented were formatted in such a way that participants were required to share knowledge specific to their role with others in order to complete the task. This mechanic therefore had a direct impact on developing the skills required to meet the learning outcomes. Other examples of this in the experimental prototype developed include the use of the 'cascading events' mechanic which required

participants to forward plan (supporting LO2), and, a ‘story telling’ mechanic which required participants to reflect on their journey and produce a narrative in the form of the collaborative map (supporting LO3).

- The creation of a series of experiments to measure the impact of game mechanics on learning outcomes.

This objective was met with the design and implementation of a coherent games-based activity which took an iterative approach enabling adjustments to be made which were focused on supporting learning outcomes as much as possible. There were three iterations of the activity, each building on the last with a number of recommendations for future development. The learning outcomes were met, however the sample size was small and further testing would be required across a larger sample size to ascertain confidence that those findings would be replicated.

8.2 Contribution to knowledge

As highlighted in the Contextual Review (Chapter 2) there is currently a lack of empirical evidence that supports the use of games-based learning. This research has demonstrated and documented the impact on learning outcomes that games mechanics and games-based activities can have. This knowledge can be built upon and support both further research in the field and those looking to incorporate games-based learning in their teaching practice.

The conceptual framework presented in this thesis has already been implemented in learning activities within a higher education institution and was published as a chapter within *Game-Based Learning and the Power of Play: exploring evidence, challenges and future directions* (Rooney and Whitton 2016). The framework was utilised as intended within this research and ensured that the design of the games-based activity was logical and justifiable whilst demonstrating the effectiveness of tools and methodologies discussed. This enabled the thesis to provide not only theoretical recommendations but also practical advice regarding the use of games-

based learning with Creative Arts students. This practical element covered not only the challenges and considerations around student participation, assessment and motivation, but also the use of accessible technology in the form of programmable Bluetooth beacons.

The conceptual framework presented and methodologies investigated within this research can be applicable to the design of games-based activities using any current or future technologies, since they have been designed and selected for sustainability and flexibility. The processes and recommendations are not based on specific technology being used or even on a particular activity being undertaken, rather on the principles of good design whatever the activity may be. The process that the framework outlines is just as relevant for new practitioners as it is for experienced academics. The design considerations are the same if you are new to games-based learning or already embed a games-based approach in your practice. This framework is unique in its flexibility, accessibility and relevance across a broad range of subjects. Indeed its use does not need to be restricted to an educational context, the principles of design within the framework are applicable to all games design, not only those focused on teaching and learning.

Whilst this study's primary focus was to investigate the use of games-based learning to support interdisciplinary collaboration, the process of designing and assessing a collaborative group activity demonstrated that there were new challenges and possibilities for functional contextualised assessment opportunities. This research implemented the use of Personal Meaning Maps for assessing the impact on learning of a collaborative group activity. Demonstrating that this method is effective in a group working context with guidance on how to implement it is an important contribution to the field of not only games-based learning but educational research in a broader sense. In addition Personal Meaning Maps have been highlighted as being a valuable research tool which enable the researcher to monitor the change in thinking and knowledge of participants, to revisit at a later date if needed and importantly to minimise researcher bias or the use of a pre-defined taxonomy that participants are required to adhere to.

8.3 Challenges, limitations and unexpected outcomes

There were some significant challenges experienced at different stages in the research and outcomes that were outside of the aims and objectives of the study.

The most significant challenges without doubt was the recruitment of student volunteers to partake in each iteration. As discussed in more detail in Chapter Six, test runs of the activity were cancelled *nine* times due to participant withdrawal or no-show. Multiple channels of communication were used to reach students, both formal and informal, supported by academics and by the student guild. As a result, the sample size was small. This limitation resulted in the decision to focus on testing the functionality of the concept and the appropriateness of the tools and methodologies chosen. The intention was that if the model was shown to work as intended there would be greater evidence to support the inclusion of this or a similar activity within a credit bearing module for further testing on a larger cohort.

A limitation to this study that impacted on the creative task that students were set was the lack of institutional tools that supported interdisciplinary collaboration. This effected the complexity, richness and potential of the collaborative pieces created. It was difficult to assess how much of the restriction in the collaborative process was purely due to lack of a platform, and how much was due to the work not being credit bearing and therefore not of priority. Either way the lack of this facility is an issue that would ideally be addressed before running further iterations. It would be unrealistic to expect an entire institutional repository or tool be created purely for this activity, however perhaps participants could be given more time to process their piece, giving opportunity to use specialist software and external platforms. The recommendations below address this as a wider issue that needs to be addressed at a senior management level if an institution is committed to enabling interdisciplinary working (Falmouth University has expressed this wish in its 2030 strategy).

In relation to the activity itself the challenge was ensuring the game spaces triggered the behaviours and development of skills required for collaboration. The iterative process was invaluable here as there were several design choices which

seemed logical yet in practice did not work as intended. At times this was due to underestimating the challenge level of a puzzle, at others it was failing to pre-empt where participants would attempt to individually solve a puzzle rather than collaborate. The feedback from groups and the iterative process allowed for these points to be addressed, however it highlighted the challenges related to good game design and the importance of experimental prototypes.

In terms of unexpected outcomes, the earliest example was as a result of examining the literature on collaborative learning and this method of working in the Creative Arts. The skills stated as being required for collaboration were often very generic and did not seem to differ regardless of the context in which collaboration was being discussed. Creative practices were being said to benefit from collaborative activities, however the skills that specific types of collaborative working would require were not being isolated and named. Aside from the traditional list of skills e.g. communication skills, leadership skills, ability to compromise, team player etc., it seemed clear that there were three core abilities needed for successful collaboration in creative endeavours; conceptulisation, visualisation and improvisation. In every creative collaboration at some point practitioners will be 'pitching' or 'conceptualising' their idea to others. There is a definite skill in being able to effectively describe your artistic proposal and its aims. Similarly there is a skill to being able to visualise one's own and other's ideas. In a collaborative context visualisation not only requires listening to others, but also understanding what they have said and at times empathy alongside a vision as to how their approach can fit with your own practice. Finally Improvisation is an essential skills in interdisciplinary collaboration. Even if a collaborative piece of work is carefully planned as you bring multiple disciplines together there are frequently moments where decisions outside of one's normal mode of practice need to be made. To revisit Miner, Bassoff and Moorman's (2001) definition of improvisation, there must be a 'degree of novelty' in the intended action; in that behaviours are not based on pre-existing routines and actions cause deliberate, as opposed to accidental, outcomes. The identification of these skills specific for collaboration in the Creative Arts was not an objective of this research but did help shape the design of the activity.

It was also not an objective of this research to record the experiences of collaboration that students had experienced before reaching higher education. However it quickly became apparent, from both the academic staff interviewed and from the students themselves, that collaborative working is not a way of learning that students have experienced regularly, if at all, in their education. With collaboration not being assessed in schools and further education it becomes less surprising that students often lack the confidence and the skills to effectively group work at university. An essential element of collaboratively working is being to manage the social and academic issues that may arise. An unexpected outcome of this research was the revelation to the researcher of the individualistic agenda of education. Contemporary higher education is increasingly being asked to equip students with the tools to work with others yet there is a lack of guided collaboration throughout the education system. This individualistic approach is bad for everyone; students are increasingly taught a narrow slice of their subject to maximise exam success, academic departments remain siloed and employers receive graduates for whom working collaboratively is learnt 'on the job' as opposed to being equipped with the necessary skills. Whilst this study explores the use of games-based techniques to support collaborative learning in higher education, it is apparent that activities to support collaboration throughout all levels of education would benefit from further study.

8.4 Recommendations and further development

As discussed earlier in the thesis the primary recommendation would be to test the games-based activity in a credit bearing module. As well as having a larger cohort to collect data from the sample would no longer be self-selecting, increasing the validity of the results. Since all participants in the iterations documented in this study were volunteers, we assume they had a positive outlook towards the use of games, indeed some of the participants were students from a games development course. Therefore the impact on learning could be more muted when concerning those who aren't so familiar or positive around the concept of games for learning.

Development of the conceptual framework into a resourced toolkit to guide the creation of games-based learning activities would be a logical and straightforward next step. By signposting to tried and tested tools, methods and resources the conceptual framework would not only guide the design but provide peer reviewed resources to assist with development and knowledge acquisition. The framework and associated resources would need to be accessible and a digital format is proposed as the most effective way of achieving this with each element of the framework hyperlinking to relevant content. This researcher supports an Open Educational Resources (OER) approach and under this model of openly licensed content there would be scope for others to also signpost to the tools and resources they have found useful at different stages in the framework. To further expand on a digital version of the conceptual framework, relevant examples of case studies or practical applications of the process could be linked to each stage, including a variety of delivery methods to make the resources as accessible as possible. Short screencasts, interviews, written case studies and learner feedback, could all be linked to at relevant junctures, resulting in a conceptual framework tool that not only guides but provides a snapshot of the practical experience, shares examples of good practice and links into the community of practice.

In terms of the activity as it stands there is scope for improving the opportunities for participants to record and combine their work whilst navigating the outdoor space. In the study, groups relied on their mobile devices to capture photos, writing in notebooks and audio recordings. The webpages that display the puzzles and clues could be developed to include the option for uploading content as it is created, making the process of designing the collaborative work a little easier in terms of having digital content in one place, and linked to a particular section of the game.

Following on from compiling the raw material, identification (or creation!) of an open source collaborative ePortfolio tool to assist interdisciplinary collaborations would be the final recommendation. A significant barrier to the ease of fulfilling the in-game creative task was access to suitable tools or platforms to combine multimedia content from multiple people into a singular piece. There were no ePortfolio tools subscribed to at the institution where this pilot was held that were

accessible or suitable for this purpose. Provision of institutional platforms and tools that allow for creative collaboration between students will be essential if interdisciplinary collaboration is to fulfil its potential. Consideration needs to be given as to how students will be able to transition with these portfolios as they leave their studies. Often staff will encourage students to create artist profiles on sites such as *Artstation* or *Behance*, however this is very much aimed at the individual rather than encouraging the showcasing of a collaborative experience. Increasingly there is focus on the entire lifecycle of the student experience, which includes access to resources, work and assessments as a graduate, a 'living' portfolio is one aspect of this. Decisions around institution wide educational technology needs to be addressed jointly by senior management teams and educational technology teams, and resourced appropriately. Many universities understand the importance of introducing students to industry standard software and tools within their own discipline, the same value should be recognised and effort applied to sourcing the appropriate software, platforms and training opportunities that would enable students across different courses to collaborate.

As acknowledged throughout the study, group work can be extremely difficult to assess, this study took the approach of assessing the participant through an individual task in the form of the Personal Meaning Map. If future iterations were being developed the researcher suggests that investigating the feasibility of scoring interactions within the collaborative activity itself could contribute positively to the contextual assessment of collaborative working. One method of doing this would be to score for behaviours and interactions that facilitated or detracted from collaboration in a group. This type of assessment was used by Wilczenski et al. (2001) who observed interactions in collaborative problem solving groups. Should an individual's contribution to the process of collaborative working be assessed it is recommended that the conclusion from Orr's (2010) study is considered, which highlights the importance of ensuring students are confident and fully informed as to the marking criteria. Orr suggests 'the assessment weightings given to process/product and individual/group are carefully considered by the course team and discussed with students (2019: 311). Taking this step can minimise the tension

that can be caused by assessment anxiety as well as preserving the risk taking behaviour that is central to the creative process.

8.5 Is the gap still there?

The recommendations above have resulted from a study that has taken place over a seven year period. As outlined in the first chapter, since this research began there have been continued developments in the field of educational technology and also in games-based learning. It is appropriate to question whether there is still a need for this research or whether the gap in knowledge has been filled during this time?

A search of the literature does not return any substantial work around games-based learning studies that specifically consider Creative Arts HE education. Subhash and Cudney (2018) conducted a systematic literature review of peer-reviewed journal articles concerning games-based learning published in English. They looked at the period of time between 2012 and 2017, whilst this research was being undertaken. A variety of keywords and phrases were used to capture articles that covered games-based or gamified learning in higher education. 602 papers were initially discovered however once duplicate search items, grey papers, those without full text in English and those not clearly confined to games-based learning in higher education were discounted, there were 41 papers remaining. Figure 8-1 shows there was not a single paper concerned with a subject area in the Creative Arts.

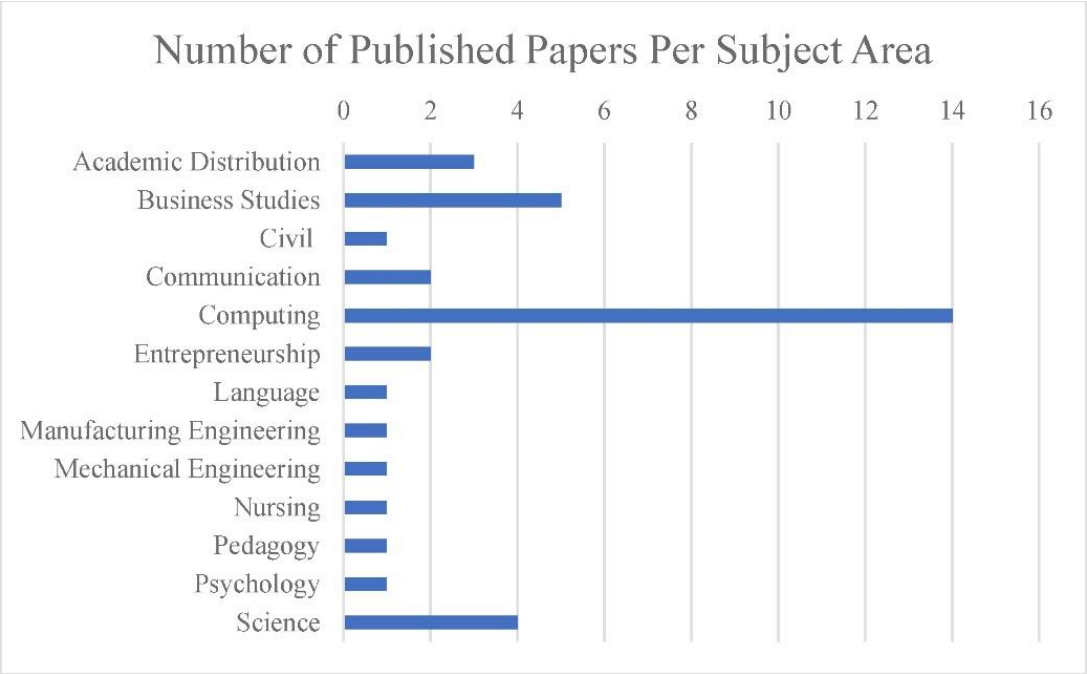

Figure 8-1: Number of papers published on gamified learning in each higher education subject area (Subhash and Cudney 2018:204)

This raises the larger question of why do we think we want games-based learning in Creative Arts HE? There are numerous studies discussing the potential benefits of games-based learning across these other subject areas. As was the case in the contextual review, many credit games-based learning for supporting creative thinking and collaborative working both within and outside of the classroom (Pánek et al. 2018; Subhash and Cudney 2018; Barr 2017; Denham and Guyotte 2017). Denham and Guyotte (2017) recognise the potential for games-based learning to support constructionist and collaborative learning. Their work does not however focus on how games-based learning could benefit Creative Arts instead they focus on how the pedagogical approaches used in Creative Arts teaching could be applied to games-based learning, particularly the concept of creating 'critical makers' and involving students in the process of design. This supports the thinking behind both the design process of the activities used in the course of this research and also the suitability of games-based learning for those in the Creative Arts. Additionally Denham and Guyotte (2017:31) identified from the literature that currently there is a trend in games-based learning to focus on 'traditional learning outcomes such as mastery of facts', rather than supporting the development of twenty-first-century

skills and higher order thinking skills. This study has argued the importance of ensuring students are given the opportunity to work through Bloom's orders of thinking in order to achieve the best learning experience, particularly for the development of interdisciplinary collaborative working.

Yet within the literature there are still concerns as to whether there is sufficient data to demonstrate impact on learning and questions around the resources and ability to produce games for learning (Bryan 2019:28). Whitton (2018:2) observes that 'Playful learning in Higher Education currently lacks a coherent definition, evidenced pedagogic rationale or framework of implementation approaches'. In addition to the lack of research available around games-based learning in HE Creative Arts curriculum, it is apparent that there is still a gap in knowledge and the research presented here contributes to addressing these concerns.

As this study shows there is a need for further research into games-based learning in the Creative Arts, into the importance of interdisciplinary working and how the two can come together. However, the issue of dissonance felt by students whilst working and being assessed in groups needs to be addressed. Students often report feeling like they have to choose between working to get their best possible grade as an individual and being the best team member they can be, which may involve compromising what they personally believe to be the best approach. Whilst appreciating they may have to work with others in industry, many are reluctant to engage with group work, often due to dissatisfaction with how they perceive the work will be assessed. An educational experience lacking in collaborative experiences has embedded an individualistic approach for students. Assessment in group work is, as it was when this study was first started, a contentious issue for students. Information gained from observing and evaluating collaborative group activities, such as the type proposed in this study, can feed back into the design process, improving the experience for students partaking in group work. This applies not only to the activity itself but also to the way the experience is assessed. Considering new methods of assessment that enable the impact on the individuals learning is key to meeting students' objections or concerns relating to group work. The method used in the study and the alternative method briefly referred to in the

recommendations above (to score for behaviours and interactions) could both be of use to others looking to design small collaborative activities.

Universities are still looking to improve their graduate employability, often employers are consulted on the skills they are looking for in graduates to their field and students are wanting to leave their course as desirable employees. The Personal Meaning Maps clearly showed that students considered interdisciplinary working to be a skill required for employment. There will always be a gap in the student experience between academia and industry, however there is the potential for this type of interdisciplinary collaborative games-based learning to offer a more authentic route for learners.

Collaborative games-based learning by its nature presents students with a challenge, rules within which they can operate and a requirement to work with others towards a positive outcome. Can it elicit a similar emotional response as one would experience in industry? Whilst it will not reflect the workplace entirely, this type of activity can certainly provide an insight into interdisciplinary working. Yes, non-traditional modes of assessment will be needed (such as the Personal Meaning Maps used in this study), however a traditional *standards based approach* to education can be in direct opposition to the desire to encourage learners to think innovatively, creatively, break boundaries. Games-based activities, such as used within this study, encourage participants to think and collaborate in ways that are not possible in a didactic, passive, seminar or lecture.

8.6 Towards the future

There are always a variety of new tools and technologies on the horizon or sitting at the periphery of mainstream education. The inclusion of some technologies in education have been driven by the changing landscape of higher education. Financial pressures facing many institutions in the sector, providing value for money to students who often view themselves as customers and competing globally in terms of reputation, has meant that technological solutions are being sought to ease these pressures. Whether that is ensuring meaningful dialogue with students,

identifying particular learning needs for individuals or supporting assessment and feedback, technology is providing us with opportunities to increase the personalisation of education.

The use of Bluetooth beacons in this study will enable others to build upon this experimentation and use of these beacons within the context of an educational activity. There are different examples of the code required to use the beacons in innovative ways that are available in open source forums. Incorporating beacons into educational practices will enable further evaluation of their value and appropriateness.

In the near future we can expect to see change driven by democratised Artificial Intelligence (AI) in the form of personalised experiences for students delivered via online assistants, conversational AI platforms and smart virtual learning environments that amend what they present according to the individual's needs. Virtual Reality (VR), Augmented Reality (AR) and the widespread adoption of 360 video capture are bringing new and exciting possibilities for the Creative Arts. Objects can be used in AR activities enabling the digital / in real life divide to be softened, presenting new opportunities around skills development. Early adoption of these technologies are starting to result in the creation of digital fieldtrips, virtual collaborative performances, the ability for multiple users to simultaneously interact, digital storytelling and opportunities to address inclusivity and diversity challenges. This has not gone unrecognised by government, in June 2019 it was announced that The Department for Education (DfE) had set up a multi-departmental artificial intelligence (AI) horizon scanning group to explore how AI might impact the UK's education system (Trendall 2019). The team is comprised of digital, policy and delivery professionals who will consider all aspects of AI in education, from automating tasks such as marking to enhancing content delivery. Alongside a significant investment of £20 million in GovTech initiatives to increase uptake of AI use in the public sector (Department for Digital, Culture, Media & Sport 2019), and also the DfE becoming a member of the new Institute for Ethical AI & Machine Learning, it is clear that there is an awareness and commitment from those who set policy to explore the benefits of AI and associated technologies to education.

Each advance in technological or pedagogical innovation requires investment of time, resources and energy. That is not a reason to disregard innovative development, but it is a reason to design for evaluation and monitor impact. With meaningful and purposeful evaluation of experimental interventions or methods we can identify how these can make the most positive impact on learning. Learning experiences need to generate a change in students – either in knowledge or behaviour; it is essential we start to record that change and critically consider how it was achieved.

Each development has the potential to disrupt established ways of learning and the advent of technologies outlined above will force consideration of alternative methods of digital assessment. We are already beginning to see changing modes of learning, in part due the Internet of Things bringing new possibilities to campus based courses as well as the growth in micro-credentials and online learning. Employers are influencing course content and in some cases becoming co-creators of content. Underpinning all of these incoming technological disruptions however is the importance of good teachers and active, collaborative learning activities. No technocratic solution is going to be a panacea for poor pedagogy. Indeed, whilst new technologies are being explored and consideration given to how they may impact education, so our pedagogical approaches are also being examined, questioned and developed. Over the last ten years there has been a significant increase in interest regarding the concept of Playful Learning pedagogies in higher education. There is recognition that it stems from the same constructivist learning theories that underpin widely accepted principles of learning. That learning is an active, social and contextual activity, it takes time and requires motivation. The philosophising around the epistemology of play and learning has transformed into a field of practice-based, evidence driven research. 2019 saw the launch of the open access Journal of Play in Adulthood, providing a forum in which to discuss, share and increase the understanding we have of play in adulthood, the benefits it can bring and the place it can have in education, the workplace and beyond.

Academic publishers are supporting the publication of texts related to play in adulthood. This year Routledge have published '*Playful learning: events and activities to engage adults'* (Whitton and Moseley 2019) an overview of how play

can be of value in adulthood, demonstrated through a collection of case studies and providing practical examples that can be incorporated into adult learning. As well as considering the use of play in learning, the benefits of play in the wider society are being debated; 2019 also saw the release of '*Play and playfulness for public health and wellbeing'.* (Tonkin and Whitaker 2019). Elsewhere, Springer have included a chapter entitled *'The importance of play and playful learning in higher education'* in their *Encyclopaedia of Educational Innovation* (James 2019), again providing the all-important case studies to back up the theoretical context.

Whilst it is important not to conflate the ideas of playful learning and games-based learning, - a playful learning approach may be taken without the use of a specific game, there is clearly a relationship in the pedagogies underpinning the two approaches. The newly launched Playful Learning Association has developed from the Association for Learning Technology's (ALT) Games and Learning special interest group established in 2010, which went on to change its name in 2016 to The Playful Learning special interest group (PLSIG). This shift in focus from purely games to play reflected the development of a wider community of people interested not only in games but also the academic study of play.

The growth of this field is resulting in many new practitioners and researchers within higher education becoming aware of and wanting to implement techniques such as games-based learning. An evidence base is needed to demonstrate the value and promote discussion. This study is just one of many resources bringing together case studies and empirical evidence that can be drawn upon to for support and guidance.

The fundamental requirements for teaching and learning have not and will not change. However knowledge is being shared and constructed, whatever technologies are being used to support that; there will always be a requirement for distinct learning outcomes and educational activities that have been designed to clearly meet those. As different modes of delivery are embraced and different styles of learning are acknowledged, so our ability to be flexible with our pedagogical methods is essential in order to capitalise on the benefits that developments in technology and teaching will bring. Currently there is a lack of

awareness of the pedagogy of games-based learning, and there are other barriers to alternative approaches to assessment. The only way this will change is if policy makers and directors of education can turn to sound empirical evidence coupled with practical, scalable methods.

In summation, this study demonstrates that a fully-realised game does not need to be created in order to benefit from the positive impact that games-based learning can deliver. The incorporation of game mechanics, when done in a methodologically sound way, can enhance and enrich learning activities. In particular this study has highlighted that interdisciplinary collaboration is a vital skill that Creative Arts undergraduates need to develop and that games-based activities can support this. This study has shown that an underpinning framework and methodology are essential for the success of games-based learning. Whilst further research is required with a larger cohort to test the findings presented here, the required framework, pedagogical approaches and methodologies demonstrated in this thesis are sustainable, fit for purpose and will support others looking to implement and evaluate a games-based approach.

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Appendices

Appendix One: Participant consent form

Participant Consent Form – The Map Game

Thank you for volunteering for this study, which is part of a research project on Games-based Learning in the Arts. I am interested in evaluating the use of games based techniques to encourage inter-disciplinary collaboration. Please read the attached information sheet for further details regarding this research project.

I will ask you to partake in a games based activity that will involve you walking around the campus as part of a group, recording your journey in any way you wish, collectively. You will then be asked to curate the resulting content and present the resulting 'map'.

The data will be entirely confidential and are for research purposes only. If any maps, data or direct quotations from the workshop are used in the final thesis, academic publications or presentations I will not use your name; you will be an anonymous participant.

Consent

I understand that I have given my consent for information gathered during this activity to be used, for the purpose of this research project.

Statements of Understanding

I have read the information about the research project which I have been asked to take part in and will be given a copy of this information to keep if I desire. I understand what is going to happen and why it is being done and I have had the opportunity to discuss the details, ask questions and amend final record before publication. I can request a copy data I have produced during this activity.

Right of withdrawal

Having given this consent I understand that I have the right to withdraw from the activity at any time without disadvantage to myself and without having to give any reason.

Statement of Consent

I hereby fully and freely consent to participation in the study which has been fully explained to me.

Signature

Participant's name (BLOCK CAPITALS): _____

Participant's signature: _____

Date: _____

Researcher's contact:

Steph Comley
Falmouth University
SC110002@falmouth.ac.uk

Participants Record

A duplicate copy of the consent form is available for the participant to keep for their own record.

Appendix two: Interviewee information sheet

Game-based techniques and collaborative learning between arts students in Higher Education.

This information sheet is intended to provide you with further information regarding this research project that is considering the use of Games-based learning to support inter-disciplinary collaboration amongst arts students.

I'm hoping to develop an activity that will encourage students to work with others from different subject areas, using Games-based techniques to encourage and motivate them. As part of this study I want to look at the current use of Games-based Learning in the higher education arts sector. I also want to talk to academic staff and learning technologists working in the HE arts sector regarding their perceptions, expectations and personal experiences of Games-based Learning.

Research Interest

How can the implementation of game-based techniques delivered through digital resources impact collaborative learning between creative arts students in Higher Education (HE)?

This research will consider theories of Collaborative Learning, the use of digital resources to encourage student collaboration, and the application of game mechanics to digital activities.

Aims

To contribute to educational theory regarding game mechanics in digitally enabled learning experiences by identifying how game mechanics can enhance collaborative learning between arts students in HE.

Identify how specific game mechanics impact on specific learning outcomes.

Objectives

The creation of a conceptual framework regarding the application of game mechanics to digital resources in the creative arts.

The identification of examples of digital resources incorporating Games-based Learning used in HE.

The investigation of the pedagogy of collaborative learning theory and its influence on the design of digital resources.

Creation of a series of experiments to measure the impact of game mechanics on learning outcomes.

Appendix three: Semi-structured interview questions

1. Thinking about your own learning experiences … please could you share any experiences of having learnt something using games or games-based techniques. This could be one or more of the following:
    a. As a young child
    b. In Secondary school
    c. In University
    d. As an adult
    e. Have you partaken in any 'games for change' / 'serious games' online, for example *FoldIt*?

2. Have you supported the use of games or games-based techniques in teaching practice? You may wish to consider:
    a. Was this aligned to specific learning outcomes?
    b. Did you feel it had an impact on student's learning
    c. How was the activity received by students/
    d. Would you repeat the process?

3. Do you know of any examples of other academic staff using games or games-based techniques in their practice?
    a. Have you come across any references to Games-based learning in conferences / journals or other sources related to your practice?

4. What, if any, objections or resistance to using games in learning have you encountered?
    a. How do you think that may be overcome?

5. Do you feel you have the necessary support and resources to be able to support the inclusion of games based activities in teaching?
    a. Do you feel staff know how to contact and use the support of the Educational Technology team?
    b. Would it be useful to have a framework to refer to re: the incorporation of games based activities into teaching?

6. What skills do you think are essential for collaboration between arts students?

Appendix four: Promotional flyer

Appendix five: Scoring across all dimensions for participants

Dimension one: Extent			
Participant	**Pre-activity**	**Post-activity**	**Difference**
G1:1	8	11	3
G1:2	9	11	2
G1:3	18	23	5
G1:4	14	20	6
G1:5	6	8	2
G2:1	4	10	6
G2:2	4	8	4
G2:3	9	16	7
G3:1	11	16	5
G3:2	14	20	6
G3:3	11	18	7
		Average	4.8

Dimension two: Breadth			
Participant	**Pre-activity**	**Post-activity**	**Difference**
G1:1	5	7	2
G1:2	3	4	1
G1:3	6	8	2
G1:4	4	7	3
G1:5	4	6	2
G2:1	2	7	5
G2:2	2	5	3
G2:3	4	6	2
G3:1	4	7	3
G3:2	5	7	2
G3:3	5	8	3
		Average	2.5

Dimension three: Extent		
Participant	**Pre-activity**	**Post-activity**
G1:1	1	1
G1:2	1	2
G1:3	2	2
G1:4	2	2
G1:5	1	1
G2:1	1	1
G2:2	1	1
G2:3	3	3
G3:1	1	2
G3:2	2	2
G3:3	2	2

Dimension four: Mastery			
Participant	**Legitimate links Pre-activity**	**Legitimate links Post-activity**	**Increase**
G1:1	0	0	0
G1:2	3	3	0
G1:3	8	8	0
G1:4	5	6	1
G1:5	0	0	0
G2:1	0	0	0
G2:2	0	0	0
G2:3	3	4	1
G3:1	0	5	5
G3:2	8	11	3
G3:3	9	16	7
		Average	1.5

Total scores across all dimensions			
Participant	**Pre-activity**	**Post-activity**	**Difference**
G1:1	14	19	5
G1:2	16	20	4
G1:3	34	41	7
G1:4	25	35	10
G1:5	11	15	4
G2:1	7	18	11
G2:2	7	14	7
G2:3	19	29	10
G3:1	16	30	14
G3:2	29	40	11
G3:3	27	44	17
		Average	9.0

Appendix six: Completed maps from the creative task

Group one

Group Two


They walk far, into a new world,
even though it is part of the old world.
Though the hanging fruits and flowers may go rotten,
Your names carved in stone will not be forgotten.
Peaceful are the trees, peaceful blows the breeze,
May peaceful be the rest you take in ease.
Each obstacle you shake, each solve you make, has carved a hidden path to take.
And what it'll show, when it's all explored and done:
You're a star baby, so shine bright like one.
Details, it's no longer about how the place feels,
but what it looks like.
Where are the teardrops, the diamonds, the evals?
A garden contained, walled, controlled.
Trees planted in rows, apples rotting in a rusting water tank.
Order, order, order! Colours are codes and numbers the answer.
Three corners make a triangle and the adventure begins.
One foot in front of the other, they know these grounds,
but do they really know these grounds.
Split up! You go here, and you go there. Solve your own puzzles by solving one together.
Speaking without words, signs from a distance.
She has the questions, he has the answers. What do you know about body language?

Group three