

PROCEEDINGS OF THE 6<sup>TH</sup> IRISH CONFERENCE ON GAME-  
BASED LEARNING

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EDITED BY PATRICK FELICIA, NEIL PEIRCE, MAIREAD BRADY AND ANN DEVITT

IRISH CONFERENCE ON GAME-BASED LEARNING

Proceedings of the 6th Irish Conference on Game-Based Learning

Edited by Patrick Felicia, Neil Peirce, Mairead Brady and Ann Devitt

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## PREFACE

Game-Based Learning is gaining a wider recognition amongst practitioners and industry, as a relevant and efficient tool to promote and support learning and change.

This book is an invitation to explore and further understand the many facets that make game-based approaches a truly interesting and effective tool to teach and train in the 21st century. It includes thirteen chapters with content initially presented at the 6th Irish Conference on Game-Based Learning, a conference held at Trinity College Dublin this year, where researchers, practitioners, students and other stakeholders meet and share their interest in games and education. These chapters touch on some very important topics including social change, gamification, language learning, and medical training. Together, these chapters illustrate the advancements in the field of Game-Based Learning, the challenges faced by developers and educators, as well as the opportunities that this medium can offer.

Each chapter is written with practicality in mind in an effort to provide the reader with both a solid theoretical approach and background, coupled to some practical guidelines and suggestions that can be applied easily.

We hope you enjoy this book and that it motivates you to tap into the many possibilities offered by games to instruct, motivate, and lead change.

Patrick Felicia, Conference Director and Editor-in-Chief.

Neil Peirce, Mairead Brady and Ann Devitt, Conference Chairs and Editors.

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Patrick Felicia.

## CHAPTER ONE

# REFRAMING PARTICIPATORY DESIGN IN THE CONTEXT OF SOCIAL CHANGE GAMES

CLAIRE DORMANN

### **Introduction**

Participatory design has become popular within human-centred design, and it is emerging within the game-based learning community. We advocate the use of participatory design to enhance Social Change Games (SCG), as it can facilitate learning and stimulate engagement, overcoming some of the SCG design limitations. The application of participatory design to SCG is relatively new, thus applying this method can be challenging: new issues emerged that need to be solved. As we aim to develop SCG for dementia care, we propose to set a new agenda for the application of participatory design, reframing it for this context. In this paper, we first introduce SCG outlining some of their limitations, and then discuss participatory design and its application to SCG. Next, we look at participatory culture for new ways of sustaining participation. To conclude, we outline a new research agenda to support the use of participatory design for SCG.

### **Social change games**

Social change games address a number of socio-cultural issues and are becoming an important voice for activism and education. They are designed to enhance awareness of social issues, to transform players' views or attitudes, trigger real-world action and, stimulate societal change (Belman and Flanagan, 2010). SCGs deal with many issues including environmental, health and humanitarian issues. For example, *Ayati the cost of life* (GlobalKids, 2006) designed in collaboration with youth, is a game about poverty. Through the game mechanics, players have to balance work /money, health and education in the face of adversity. To create a socio-emotional experience of helplessness, the game was made to be «*easy to play, but hard to beat* » (GlobalKids, 2006). *Save the Park* (Schell Games, 2016), a game Apps, is fairly typical of some SCGs, seeking to convince and encourage players to make changes in the real world by becoming volunteers. The game mechanics mimic actions that players should take to protect parks. Players efforts are then broadcasted through social media.

Besides a greater awareness of issues and empathy toward the ply of refugees, the displaced or those suffering from mental illness, at the heart of these games is players' engagement and transformation. Players should become proactive by for example creating activism groups, and

participating in debates, and so on. SCG are not designed to work in isolation, game designers thus aim to stimulate the creation of an affinity space surrounding the game to better inform players and prompt them to act. To do so, they might create a website around the game with more facts and witnesses' accounts urging players to discuss issues through a forum. They might also suggest specific activist actions such as writing letters, or participating in protests.

One of the limitations of current games for change is that players' reactions to the game and its effectiveness depend on players' previous knowledge, values and personal experiences with the issue at hand (Sheepy, 2015). Educational experts do not always have a good insight in players / learners perspectives, values and expectations, especially with regard to gameplay. Thus, there can be quite a gap between the game content, how issues are portrayed or transmitted through the gameplay, and players' understanding of the problem. Even if a game is well liked and played, SCGs often fail to engage players beyond gameplay. Most often, the challenges and actions that players should take as would-be activists do not fit with players' contexts and circumstances. Furthermore, players' involvement should not be limited or dictated by the few actions selected by designers. Thus, to overcome these limitations and to support the development of social engagement, we propose to adopt participatory design as a design strategy for the games, reframing it in the context of SCGs and augmenting it by looking at other participatory frameworks.

We aim to develop SCGs for dementia care that stimulate empathy, conversation and community engagement. While attending carers' group and Dementia Café, initial discussions have shown the need for games that enable communication and sharing experiences around dementia care to break social isolation. Vanden and Van Rompaey (2006) working with seniors gamers highlighted important values as, connected to others and contribution to society. SCGs for dementia care could lead to a growing repository of knowledge that can be built upon, tailor and accessed by a wide number of user groups in the dementia community (people living with dementia, caregivers, volunteers, etc.). We thus turn to participatory design to strengthen the SCG games that we are designing for this particular user group.

## **Participatory Design for SCGs**

Participatory design is a design approach with a set of principles, practices and techniques which involves end-users as participants in the design process (Schuler and Namioka, 1993). Involving users is integrated in user-centered design methodologies, but participatory design preconizes a much deeper users' involvement. Users are not just informant or tester during the evaluation phase of a project, but they become partners included in decision making and giving input at every stages of the design process. Active experimentation and design by doing (e.g. hands-on design) are used in participatory design sessions, to reach mutual understanding and produce new design iterations (Nesset and Large, 2004).

Participatory design has first emerged in the context of educational software, and then more specifically for game-based learning, although in a limited capacity. Participatory design has been used for examples for mobile learning (Brandt and Hilgren, 2004) and for a multimedia language program (Zapharis and Constantinou, 2007). Participants produced content and created some pedagogical activities. Although user-centred design has gained popularity, participatory design has not been used with SCG to a great extent. Using this approach, Danielsson and Wiberg, (2006) develop a web game related to gender issues in which players were confronted by hurtful situations and should reflect on them. The preliminary concept for the game was established by the designers and then teens became involved in the design process. Teenagers provided needed insights on their

perceptions of gender issues. They also gave inputs and participated more specifically in the design of the game content, but also proposed modification to the game mechanics. Similarly, *Village Voice* is a game about conflict resolution where children should role-play and experiment with different responses to conflicts and their effects (Khaled and Vasilou, 2014). In this case, the children involved in the participatory design process responded far better to structured design activities using the game system barebones rather than at the initial game generation concept stage, which was too abstract for them.

Indeed, involving end-users having various competencies in technology, gameplay or in the educational context is quite challenging, especially when it includes vulnerable populations, such as younger children or elderlies. Pedagogical experts often adopt an explicitly didactic approach to conveying domain knowledge within games, far beyond the knowledge of future players. As Khaled and Vasilou (2014) showed while children had a good game literacy, they lacked knowledge in conflict resolution and thus had difficulties in connecting meaningfully to the subject. By contrast in the dementia context, carers are more knowledgeable about dementia and its consequences but often lack some of the computer literacy necessary to contribute to game design. Despite inherent difficulties in conducting participatory design with people living with dementia, Lindsay et al. (2012) show how important it is to involve this user groups in the design of assistive technology and games, as caregivers do not necessary convey the needs of the person with dementia flawlessly. Sessions might first be needed so that participants can explore the problem space in more depth, for examples by providing game literacy or domain knowledge (e.g. role-play) workshops.

As demonstrated by Danielsson and Wiberg, as well as, Khaled and Vasilou, through specific creative and adapting methodologies to specific user groups, participants can be involved in producing scenarios, developing and refining content as well as in designing game narratives, gameplay events and actions, etc. Participants were also well able to discuss and evaluate game design decisions as a function of the problematic and social change desired.

Games designed using participatory design should be more responsive and sensitive to user understandings and experiences. It would enhance the quality of learning, the motivation to play and likelihood to trigger changes. Despite making progress by using this method, games designed in this way would still lack the flexibility to allow for different interpretations and adaptations to different user groups and contexts. Thus we turn to participatory culture to explore participation and reframe participatory design to enhance the design of SCG.

## **From Participatory Culture to Participatory Design**

Participatory culture has been defined as “*a culture in which fans and other consumers are invited to actively participate in the creation and circulation of new content*” (Jenkins, 2006). Within the game subculture, there are a plurality of ways in which players are involved and participate in game design and co-creation through a game map, level, character design, etc. Many commercial games provide tools to do so. *Little Big Planet 3* (Sumo Digital, 2014), a fun and playful puzzle platformer, put a particular emphasis on “play, create and share” in its tagline. Players are thus given the freedom to create their own levels, characters, and game objects including decorations, vehicles, pods or home levels. Doing so will enable an approach advocated by Frasca (2001), which let players experiment and modify situations and characters according to their perceptions and experiences. Indeed, *A Force More Powerful* (2006), a game developed by the International Center on Nonviolent Conflict offers tools for players to adapt and create scenarios for their own context and use.

Participatory culture can also provide some insights into what players can and might do that would inform the design of social space for engagement. Players are spending increasing amount of time interacting online in game communities. They can be immensely creative, from producing podcasts and tutorials, as well as, Mod games to going beyond the game itself to design fiction, comic art and much more. In digital activism, citizen reporters provide first-hand coverage of events, discussing politico-social issues. Unlike most SCGs, those affinity spaces are inhabited by a passionate audience.

Thus the conceptualization of participatory design for social change games should be extended to reach beyond the game itself to include the production of an affinity space that is more attune and engaging to players. Furthermore, participation can also be increased by giving tools so future players can also become co-designers. While participatory design refers to the process, principles, and techniques used during design, participatory design is also an embedded action mode where design consists of developing emergent practices. For SCG, emergent practices are those that foster social change, community participation and citizen empowerment.

## Conclusion

As we start to develop SCG in dementia care, we advocated to adopt and adapt participatory design to this context. We highlighted the usefulness of this method for SCG and discuss issues related to its utilisation with SCG design. Games designed using participatory design should be more attune to user understandings and experiences, facilitating user responses and engagement with the game. This is particularly important when dealing with specific groups like people living with dementia, as well as, children. To enhance the likeliness of triggering social change, we then recommend to include the design of the game affinity space within the participatory design process. Furthermore, future designers could benefit from looking in more depth at participatory culture as it can provide new ways of sustaining participation and new game interpretations, as well as, creating successful affinity spaces.

As participatory design for SCG is quite new, we put forward a new research agenda to support its use. Such agenda, can be framed initially around key questions related to participation, tools and methods, as well as, to the design of affinity spaces:

- What lessons can we learn from other participatory frameworks (e.g. citizen participation or participatory education)? What are the different interpretation of participation within those frameworks? Looking at participants' roles, practices and issues could further inform the use and development of participatory design for SCGs.
- How can we better support users' involvements in participatory design? What methods should we develop in this context to facilitate participatory design with vulnerable populations such as older people and people living with dementia? How do we scaffold the problem space to support users in generating ideas? How do we evaluate resulting ideas?
- In what ways can we support co-creation within the design process and beyond the game itself? What tools and mechanisms should we provide? How do we move from the game sphere to digital activism and advocacy, and from participation to action? How do mesh and stimulate interconnections between online and offline activities? Are they game format or game mechanics that might better support this process?



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## CHAPTER TWO

# GAMIFYING A FRENCH GRAMMAR CORPUS: THE TRANSITION FROM A PAPER-BASED TO A DIGITAL LEARNING ENVIRONMENT

NATHALIE CAZAUX AND ODETTE GABAUDAN

### **Introduction**

Numerous reports have highlighted the need to address the national language skills' shortage (e.g. 2015 National Skills Bulletin, Ireland's National Skills Strategy 2025, National Employer Survey, 2015). At the same time, it is well established that students in the Irish Higher Education system have very diverse learning needs who need flexible learning opportunities (National Strategy for Higher Education to 2030, 2011). In terms of language learning, emerging digital technologies provide an opportunity to enhance the quality and delivery of language teaching (RIA, 2011). The introduction of gamification in language learning is a pedagogical strategy that can help increase motivation (Figueroa, 2015) in a technology dominated world. Research has also shown that a majority of students report not having enough support when transitioning from second to third level (Farr and Murray, 2016). They struggle with the expectation of becoming more autonomous in an environment where the teaching approach differs significantly from the one that is familiar to them. Furthermore, in a survey (Gabaudan, Ni Chasaide, Spain, 2016) conducted as part of the digilanguages.ie (project, language learners identify grammar as one of the three most challenging areas of learning a language. Against this backdrop, the resource presented in this paper is the result of a collaboration between three lecturers of French who identified the need for an overarching interactive learning tool, specifically designed for students who wish to understand and practice their French grammar in an integrated and playful manner. The resource is open, easily accessible and closely aligned to the learning outcomes of our modules, particularly in terms of grammar. The flexible format of the resource and its e-learning dimension facilitate autonomous learning as well as blended learning, thus contributing to a learner-centred pedagogical approach.

### **Literature Review**

The first field of research which influenced our project is Universal Design for Learning or UDL ([www.udlcenter.org](http://www.udlcenter.org)). Universal Design for Learning brings together different approaches that

enhance the learning experience. CAST (Center for Applied Special Technology - [www.cast.org](http://www.cast.org)) advocate, disseminate and implement this vision. In the last 15 years they have developed UDL guidelines (Rose and Vu, 2010) based on extensive research from many fields (cognitive science, neuro-psychology, education, psychology, linguistics, etc.).

Among other principles, UDL recommends the inclusion of multiple means of representation. Presenting the same information in aural, written and visual form, learners have various options for perception and clarification. Another important principle of UDL is to offer multiple means of action and expression to learners. These variations of responses are present in the diversity of the games provided on our website. In order to promote engagement in learners, UDL proposes to increase choice and autonomy as well as minimise distractions and threats. However, efforts from teachers and learners alike need to be sustained to achieve improvement.

In parallel, we decided to explore the potential of gamification to enhance learning and increase motivation. As White & Le Cornu (2011) explain, our third-level students' typology ranges from nervous "visitors" to the more comfortable "residents" of the digital space, so we needed to create a non-threatening learning environment. Making the learning environment playful helps "creating a sense of enjoyment [which] contributes to positive and successful learning experiences and attitudes towards engaging with online learning" (Salmon, 2013: 182). We actively sought to promote "a state that generates pleasure, gratification and intrinsic motivation for the participant" (Salmon, 2013: 181) by using templates and diverse format of games and exercises.

Playfulness might be key since "in games the player can experiment, explore and try out new things without risk of negative outcomes outside of the games." (Whitton, 2012: 14). We aim to "create a sense of fun and enjoyment, removing some of the stresses and pressures that are often associated with formal education, and allowing learners to engage with the game activities in a relaxed and light-hearted manner" (Whitton, 2012:14). Research has also found that "games offer a different way in which to approach learning and teaching, and the use of a variety of methods (...) can be motivational in itself" (Whitton & Moseley (2012: 15). For pedagogical reasons and with the learner's motivation in mind, we were vigilant regarding the level of difficulty of both the story and the associated games. Motivation to play the games should be intrinsic, with the "belief that a winning outcome is achievable" (2012:15). Motivation is also of an extrinsic nature as the content is closely linked to the curriculum and subsequent exams.

In her recent book on online learning, Salmon (2013: 47) states that "providing small discrete chunk of tasks helps, since these can be satisfying in themselves". Salmon warns to "avoid 'punishment' and threats to non-participants or forced attempts at achieving contribution through assessment – they do not motivate" (2013: 169).

It has been noted that knowledge and recall is especially appropriate and widely used for some aspects of language learning. Whitton & Moseley posit that "this type of [basic] challenge is associated with the lower levels of learning, such as remembering and recalling facts, and is commonly used in educational 'games' because the question-answer format is easy to design, test, and provide simple feedback for. It is also a useful format in areas where facts simply do have to be learned: language vocabulary for example." (Whitton & Moseley, 2012: 25). Finally, gamification also means that learners experience a sense of control, which taps into to the concept of learner autonomy, a well-established prerequisite to successful language learning as learners feel in control of their decision making processes (Casim and Yang, 2013).

## Methodology

The transition from a paper-based to a digital learning environment was first envisaged in terms of the development of an e-book, with features pertaining to the field of Universal Design for Learning (Rose & Gravel, 2010). However the e-book software that we considered was either too expensive or too reductive. Ultimately, the creation of an interactive website seemed to be an appropriate alternative. The challenge was to make the transition from an already constituted paper based corpus to a digital interactive format. Before embarking on the development of the digital resource, we built a design framework that would ensure coherence and integration of the various components of the resource. The framework is made up of three main sections namely the story, the grammatical explanations and the exercises. Figure 2.1 below shows the key structure of the resource as well as its internal connections.

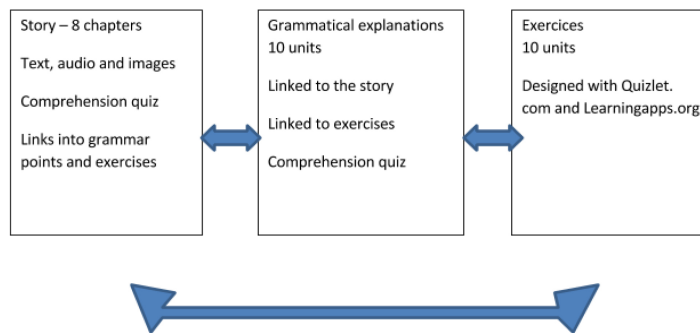


Figure 2.1: Design framework for Frenchgrammartour.com

Of primary importance was the integration of the grammar points with both the story and the accompanying exercises. Each page also had to include at least one call for action either in the form of a quiz or an exercise. The result can be accessed at frenchgrammartour.com. Figure 2 below shows the welcome page for the website.



Figure 2.2: Welcome page for Frenchgrammartour.com

The input of an e-learning developer helped us design a calm learning environment to help concentration, with few moving objects or bright colours. However, the story is supported by extensive imagery, which gives an identity to the overall project.

The text in the grammar explanations is as light as possible. With this in mind, we used a hovering tool for any of the irregular conjugations – of which there are many in French!

Salmon's (2013) 'building motivating e-tivities' resources for practitioners was used in the design of the website's activities. As an independent learning resource for students who are under time-constraints, it was important to keep the content light, present information (grammar

explanations) and exercises in small chunks, all in order to avoid cognitive overload. Automated feedback is built in for the vast majority of exercises thus supporting the learner's recall and clarifying issues with some explanations where feasible. We used apps such as Quizlet.com and Learningapps.org to create and embed the games and exercises. The types of games include quizzes, individual race games against time, race games against other players or the computer, hangman, matching words with pictures or with other words and crosswords.

The website itself is built with Wordpress.com. Here we had the benefit of a webmaster's expertise. He helped us with settings, plugins and input of the material. He also trained us to use Wordpress so that we could further develop it ourselves once funds ran out.

In this study, action research methodology was used on the basis that "a teacher-friendly mini-case study can be a useful data collection method for busy, practising teachers." (James, 2001: 117). The approach is one of "trailing" and the results are '(...) qualitative and illuminative rather than conclusive' Wallace (2004:47). They "will not therefore be statistically generalizable to the whole population of learners, classes, institutions, or whatever, of which this particular example is a member" (Wallace, 2004: 161). Further research is planned in the months to come with the aim of generating more conclusive results.

Learners involved in this initial study were all students of an Institute of Technology in Ireland. All students participating in the trial are post-leaving certificate who had chosen to study a business-centred topic with an addition of French. The majority of these students like French but would not go on holidays in France. Their only link with France or French would be via the lecturer, it is thus important to develop opportunities of contact with the target language. A majority of them would have a part-time occupation and would spend their time between studying, working and relaxing with friends. Many of the students may be described as 'Millennials': "having hypertext minds, craving interactivity, easily reading visual images, possessing good visual spatial skills, and having the ability to parallel process. They will prefer work in teams, will seek to engage with problems and enjoy experiential forms of learning" (Rennie & Morrison, 2013:8).

It was unfortunately the end of term when just over 40 students were able to play with the site during a classroom session but they were encouraged to follow up with open revision sessions before their final examinations. During the in class session, students were encouraged to get an overall feel for the resource by reading the first chapter of the story, checking some grammatical explanations and trying out exercises. They enjoyed the competitive element of some of the games. After class, feedback forms were sent to all students but considering the time of the year, only 8 students contributed. The questionnaire sought to identify their level of French, their level of familiarity with the resource, the device they used to navigate the resource, their opinion on the usefulness of the resource in general and on their perceived relevance of the different sections of the website (story, grammatical explanations, exercises).

The survey conducted shows that half the respondents used the site a few times while the other half used it just once. Three quarters of the respondents believe "I can use this site as often as possible to improve my French" while 25% think they can use it "now and again to revise". Nearly 90% of the students navigated the site on a desktop computer and all found the site easy or very easy to navigate. 50% of the students found they could understand most or all of the story while the other 50% found it challenging. An overwhelming majority (75%) found the story helped them understand the grammar points. Grammatical explanations are in English to ease understanding and alleviate

stress. In the last open question on what else they would like to see on the site, one student answered “more French culture” while another stated “more about France”. Figure 2.3 shows that quizzes and filling the gaps activities are appreciated most, “I kept doing the exercise until I got everything right and feel I know it well now” (student’s feedback).

Which type of exercise do you like best? (8 responses)

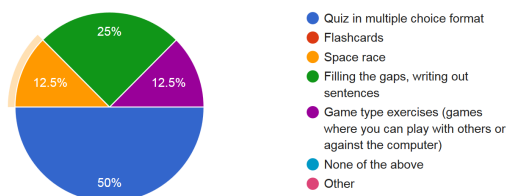


Figure 2.3: Respondents’ rating of different types of exercises

## Discussion

Casim and Yang’s (2013) ownership strategies model in online learning underpins our own framework (Figure 2.1) and served as a checklist. Core principles drawn from Casim and Yang’s model include multiple learning pathways, high levels of interactivity, multiple navigational aids, and a range of instructional options, an interactive interface, and support for self-monitoring. The resource also had to allow learners to use their own learning styles, relate tasks to learners’ ability, needs and interest.

The use of competition for some of the games worked well in class at the initial try out and served to underpin learners’ motivation. It also shows that gamification in language learning does not need to be too elaborate to bring positive reinforcement in the learning experience.

Time and money constraints meant we had to focus on what was available for creating games and exercises. For this initial phase of the project, we followed the behaviourist rationale using repetition and low-level thinking but the next phase of the project will see the development of more complex games, adding features such as badges and league boards to further enhance motivation and provide another form of gamification as well as feedback.

Though encouraging, the insights provided by our initial positive findings are limited by the small number of participants. Further data resulting from future in-depth interviews or focus groups will help determine which particular gamified aspects of the resource are most effective in supporting students’ understanding, learning and motivation.



## **Conclusion**

The resource has been carefully designed in an interactive format while being easily and readily accessible via mobile platforms. The simple, yet engaging storyline brings the learner through the numerous difficulties and specificities of the French language while providing a light entertainment and an incentive to continue on the grammatical journey. Thanks to the gamification of the corpus, we are hoping that learning ownership will be fostered as learners understand the usefulness of the knowledge acquired and feel in control of their decision making processes, as well as their learning.

In the near future, we plan to develop the levels of interaction and the multimedia aspect further by adding functions where players can communicate together. There is a need to integrate some kind of forum or collective place for developing a community of users. Literature review shows that league tables may increase motivation in some cases. Furthermore, flexibility around the language available could be improved with maybe the addition of an English version of the story.

Finally, we would like to create a corpus of videos supporting the grammatical content but also helping learners to develop their overall learning skills. The digital format, as opposed to the originally paper based format of the resource is very exciting for us as language educators as with its online version, we now have unlimited potential to add material and integrate alternative modes of learning such as videos, league tables, forums or further games.

## **Guidelines**

As practitioners and proponents of the ‘teacher as a researcher’, we feel that observing learners and being guided by a learner-centred approach is the essential start to the development of any educational project. Years of practice in the classroom fueled this project. Secondly, as advocates and avid users of computer and multimedia devices, we aim to harness the affordances of new tools in order to optimise the learning experience. Finally, the input of IT professionals and web/game designers enabled us to integrate their knowledge and experiences into the development of our resource. The project would not have come to fruition without the invaluable contribution and commitment of each of the partners in this digital adventure.

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## CHAPTER THREE

# TOWARDS A FRAMEWORK FOR COMPUTER-MEDIATED DEBRIEFING IN INTERACTIVE GAME-BASED EXHIBITS

JOHN P. HEALY, CHARLIE CULLEN AND PAULINE ROONEY

### Introduction

Within the discipline of game-based learning (GBL) the concept of debriefing has been established as a fundamental component of the learning experience (Fanning & Gaba, 2007). Through debriefing, players are encouraged to reflect and question the skills they have used in the game. As David Crookall (2011, p.907) argues in the editorial for the 40<sup>th</sup> anniversary of the *Simulation & Gaming* journal:

... one thing that is **not** being done as much as it should is proper debriefing—that is, the occasion and activity for the reflection on and the sharing of the game experience to turn it into learning.

This chapter presents a proposed framework for the development of computer-mediated debriefing in interactive game-based exhibits. This framework was developed as part of the Playable Social Interactions (PSI) project at the Dublin Institute of Technology (DIT). The PSI project seeks to explore the learning and social engagement of visitors with interactive game-based exhibits through the creation of a proposed development framework and the testing and iteration of designed installations. This study, as part of the PSI project, aims to explore the role of debriefing in interactive game-based installations and the efficacy of a computer-mediated approach to debriefing.

This chapter will describe an approach to the development of an interactive game-based exhibit that has been designed to enable testing of computer-mediated debriefing. Furthermore, the proposed research questions and the research design that will be implemented for this study will be outlined. It is hoped that this study can provide insights for exhibit designers, curators, game designers and game-based learning researchers to consider when approaching the development of interactive game-based exhibits.

### Literature Review

Museums and cultural spaces utilise interactive exhibits and audio-visual narratives to explore the backgrounds and histories of their collections (Ziegler, 2015). This coincides with the changing expectations of museum visitors, as outlined by Nina Simon:

As more people enjoy and become accustomed to participatory learning and entertainment experiences, they want to do more than just 'attend' cultural events and institutions. (Simon, 2010, p.ii)

As part of this move towards interactive experiences many museums and cultural spaces have turned to the field of games in order to engage and inform visitors through play (Beale, 2011).

In the field of museum studies Falk and Dierking (2013, p.47) propose using an “identity-based lens” to categorise museum visitors into the following types depending on the purpose of their visit: Explorers, Facilitators, Professionals/Hobbyists, Experience Seekers, Rechargers, Respectful Pilgrims, and Affinity Seekers. While each of these visitors has a different experience of the museum it is the *Facilitator* type who is motivated by the social aspect of enabling the museum experience. This visitor type actively engages with the members of their group to guide their learning experience.

Within GBL the concept of debriefing is seen as a component of an effective learning experience as it prompts the player to question their interactions with the system. Fanning and Gaba (2007, p.116) outline how debriefing “represents facilitated or guided reflection in the cycle of experiential learning” in the context of GBL. Indeed, numerous researchers have highlighted the importance of debriefing to facilitate learning (Lederman, 1992; Fanning & Gaba, 2007; Rudolph et al., 2007). As David Crookall (2010, p. 907) puts it: “Debriefing is the processing of the game experience to turn it into learning”. The role of the facilitator who conducts the debriefing is similar to the *Facilitator* type visitor to the museum (Falk and Dierking, 2013) outlined above, as both are focused on improving the experience of the learner. By developing a computer-mediated approach to debriefing it is hoped that debriefing can be conducted effectively by novice and experienced visitors to the museum.

Garris et al. (2002) developed the *Input-Process-Outcome Game* model as a method to analyse games for educational purposes. This model presents debriefing as a core component of educational games that links the game experience to learning outcomes. They cite the work of educational theorists such as Kolb et al. (2000) and Dewey (1938) as influential in the development of this model. In the *Experiential Learning Model* Kolb (2014) describes reflection on learning as a process through which experience is assimilated into new knowledge by the learner.

In the field of medical training Welke et al. (2009) compared the “gold standard” of personalized video-assisted oral debriefing with multimedia instruction and found “no strong educational advantage of one method of instruction over the other.” (p.187). This study found that multimedia debriefing was an effective method for improving non-technical skills related to crisis management. While this study was limited in terms of generalisable findings to the field of GBL, it suggests that the study proposed in this chapter could provide insight into the application of computer-mediated debriefing within the field of GBL.

As Crookall (2009) argues, debriefing needs to be integrated into educational games to ensure that learning occurs.

We can insist on designing serious games that have debriefing built in as an integral part of both the software and the procedures for running the game. Thus, participants can debrief in a richer and more accurate way. They have to confront certain hard game facts, instead of denying them, as is sometimes the case during debriefing. (Crookall, 2009, p.908)

Saye and Brush (2002) developed a conceptual framework for scaffolding within multimedia learning that includes both *hard scaffolds* and *soft scaffolds*. The hard scaffolds in this context are the designed components of the learning experience and have been expanded by authors such as Chen and Law (2016) in the field of GBL to include question prompts. Meanwhile, soft scaffolds are “dynamic and situational” (Saye and Brush, 2002, p.82) thereby allowing the teacher in a classroom context to provide appropriate support. Another form of scaffolding is *reciprocal scaffolding* (Holton and Thomas, 2001, p.99), this involves a more social form of scaffolding where peers question each other in group exercises. Holton and Thomas (2001, p. 76) describe this form of social learning as follows:

Bruner (1986) observes that most learning in most settings is a communal activity and this leads him to emphasise the role of learning as a shared and social experience in the classroom. Bruner has been largely influenced by the work of Vygotsky who assigned social interaction a central role in facilitating learning.

The work of Tsai et al. (2015) suggests that immediate elaborated feedback on the game activity can improve performance in the learning activity. Wouters and Van Oostendorp (2013) reviewed the literature related to instructional support in GBL and found that instructional supports or scaffolding, which includes feedback and advice, promoted the acquisition of knowledge and skills.

*Adaptive advice* is one scaffolding approach that has developed over recent years (Zapata-Rivera et al., 2009; Kickmeier-Rust and Albert, 2010; Leemkuil and de Jong, 2012). Adaptive advice scaffolds respond to the learners' actions in the game and provide hints and tips to support the player based on their actions.

Ge and Land (2004) argue that learner interactions can act as a *soft scaffold*. Chen and Law (2016) show how both *hard scaffolds*, such as question prompts, and *soft scaffolds*, in the form of collaborative learning, can be integrated to improve student performance. As outlined by Falk and Dierking (2013, p.144) "social interactions are at the heart of virtually all museum experiences." It is in this context that the role of social interaction and debriefing will be considered as part of the PSI project.

From the literature reviewed in this section there are a number of benefits for GBL, in addition to this the importance of debriefing to facilitate learning has been considered. This study seeks to explore whether interactive game-based exhibits can be designed to encourage and support collaborative debriefing.

## Design

In order to study computer-mediated debriefing in GBL exhibits a test methodology was developed. The study will investigate the potential for the debriefing process to be mediated through the game itself. Firstly, an interactive game was created that will be used to investigate the nature and impact of computer-mediated debriefing. The game was developed with reference to the literature in GBL, serious games and simulations in order to ensure that the current state of the art is considered. The game incorporates an interactive debriefing component that can be configured to facilitate post-game, paired debriefing. This was designed to encourage both players to socially interact with one another after playing the game. This is separate to the concept of adaptive advice as it encourages socially engaged reflection on the game experience to encourage learning, similar to debriefing (Fanning and Gaba, 2007).

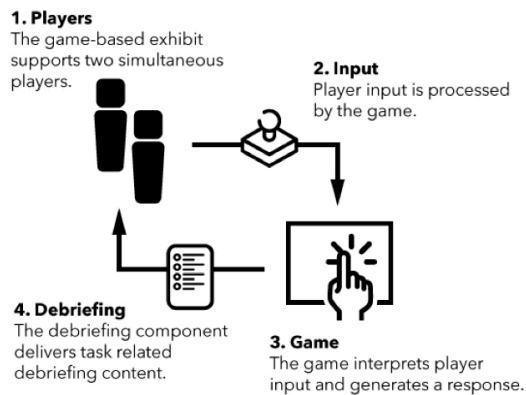


Figure 3.1: Overview of the interaction process showing the debriefing component.

Figure 3.1, above, shows the interaction flow between players and the game. The game supports two simultaneous players who input via the touch screen. It interprets this input and generates a response while gathering and preparing debriefing content based on the player actions in the game.

The game involves both players making decisions and communicating those choices to one another. The debriefing layer tracks these player decisions and replays key decision points for both players and encourages them to reflect on their choices with each other. Both players are encouraged to identify the reasoning behind their choices within the game and discuss them with one another, it is hoped that this will encourage *reciprocal scaffolding* (Hoton and Thomas, 2001) to occur.

The study will take place under controlled conditions in autumn 2016 and will involve 40 participants (20 pairs) who will be randomly assigned to the control or the experimental group. Study participants will be third level students recruited from degree programmes within the DIT. As part of the testing all participants will play the same game, the experimental group will receive computer mediated debriefing while the control group will not receive debriefing.

Pre-test and post-test assessments will be conducted based on the assessment of informal learning framework outlined by Lemke et al. (2015). By using pre-test and post-test questionnaires it will be possible to evaluate the impact of computer-mediated collaborative debriefing.

## Discussion

The game described in this chapter allows for computer-mediated debriefing to be tested under controlled conditions to assess whether this method of debriefing can encourage player reflection on the game and promote higher order learning. While the benefits of GBL have been widely discussed (Prensky, 2007; Erhel & Jamet, 2013; Tobias et al., 2014) there has not been the same focus on debriefing and reflection in the design of games for the museum context. In relation to the literature on debriefing it largely focuses on oral and instructor led debriefing which is not always possible in the informal learning context of the museum.

To consider the impact of computer-mediated debriefing in isolation a number of limitations will be placed on the study. These include the controlled conditions under which the study will be carried



out as opposed to an active cultural space. The study will be limited to two simultaneous participants as opposed to individual or larger groups. Lastly there will be no comparative group who receive oral debriefing, therefore it will not be possible to compare computer-mediated debriefing to expert-led debriefing within this context.

## **Conclusion**

This chapter has discussed the literature surrounding the development of a game that integrates computer-mediated debriefing for game-based learning in the context of the museum. Numerous authors (Fanning and Gaba, 2007; Crookall, 2009; Bilgin et al., 2015) have highlighted the importance of debriefing, however there is a lack of literature that explores the role of the games themselves as debriefing entities and in-particular debriefing in the museum context. Given the systemic nature of games and wealth of analytics data available to game designers this subject is one that requires further research. The next phase of this project will involve the testing of the computer-mediated debriefing and whether those in the control or experimental group show any differences in learning outcomes. Future work may consider the timing of the debriefing, more complex social structures and comparison with expert led debriefing.

## **Guidelines**

For designers and educators, a number of guidelines related to computer mediated debriefing are proposed:

- When designing game-based exhibits for the informal learning context of the museum, computer mediated debriefing may prove a worthwhile approach.
- Computer mediated debriefing within a game in the museum context may facilitate higher order learning by encouraging reciprocal scaffolding to take place among players.
- Adaptive approaches to scaffolding in GBL could hold the potential for supporting debriefing in informal learning contexts.
- In situations where instructor led debriefing is unfeasible computer mediated approaches may offer many of the potential benefits provided by expert debriefing.

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## CHAPTER FOUR

# GAMIFICATION FOR CAPTURING 21<sup>ST</sup> CENTURY SKILLS IN K-12 EDUCATION

EVANGELOS KAPROS AND KATHY KIPP

### Introduction

This paper describes a pedagogical design to capture 21st Century Skills. Already in 1999, there was a realisation that the workforce and the workplace landscape was changing rapidly, and training would need to reflect these changes, in what was called “21st Century Skills for 21st Century Jobs” (Stuart 1999). Despite the initial focus on the workplace, and the recognition that competency-based education is not a new concept, opportunities to re-surface much desirable student-centred pedagogies were also recognised.

With regard to scaling such approaches, one well-known approach in K-12 (the sum of primary and secondary education) is the Programme for International Student Assessment (PISA), developed by the Organisation for Economic Co-operation and Development (OECD). Other attempts include the Assessment and Teaching of 21st Century Skills (ATC21S) project (<http://www.atc21s.org/project-papers.html>) and the Collaborative Assessment Alliance (<http://janison.com/case-studies/collaborative-assessment-alliance/>). These attempts have been criticised with a number of arguments; however, one aspect that was of special interest to us was that current approaches seem to be tightly-coupled with specific tasks. Thus, it can be the case that the obtained results are a matter of the students’ skills as much as they are the result of task-design.

In contrast, we set out to develop a task-independent approach so that it would scale and maintain its flexibility at the same time. Our intention is to develop a pedagogical design, which will be developed as a software tool to be deployed at institutions of primarily K-12 education. While this is our initial focus, our design has no component that explicitly excludes informal education settings.

To this end, we designed a gamified pedagogical framework to capture 21<sup>st</sup> Century Skills in K-12 education. Then, we designed and built a tablet software application as one of the many ways to implement our framework. We sense-checked our approach with teachers and students in preparation for a future user trial. In this paper the focus is on the framework and not on the technology. Our approach is described below.

## **Key Research Questions**

### **Research Direction**

Our Pedagogical Design is rooted in the Core Question of this Research Project:

What learning and technological innovations are being used to promote and assess 21<sup>st</sup> century skills?

And are given shape by the project objectives:

- To create a common framework for how 21<sup>st</sup> Century Skills can be assessed;
- To be able to assess informal learning and social activity from learners; in particular, to research new methods of assessment which can interpret, visualise and comparatively assess learning activity implicitly and continuously;
- To create a software tool in which multiple methods and approaches to assessment can take place.

### **Pedagogical Design Recommendations**

With these questions and objectives focusing the initial research, a state of the art/state of the market review was done around these areas to identify current trends in 21<sup>st</sup> Ce. skills, their assessment, and the types of pedagogical design surrounding both of these areas. In addition to the leading frames mentioned in the introductory section, the study considered eight frames overall, taking guidance from Vooght & Roblin's (2012) comparative analysis and reviewing twenty papers in the areas of soft skills, curriculum development, assessment methods, ICT and skills and five white papers on specific assessment of soft skills through technology.

From this research, the following pedagogical recommendations were made by the authors in regards to where gaps in innovation currently exist within this space:

The design should:

- Cross grade level and content area as opposed to being grade or subject specific.
- Have longevity and breadth as opposed to being a singular activity that a student/teacher only interacts with once.
- Integrate within the authentic classroom and learning dynamic, as opposed to interfering, prohibiting, or breaking up the standard rhythm of instruction.
- Activate student skill literacy as global focus seems to have jumped straight to the assessment without focusing on the teaching and learning of these skills.
- Be rooted in a naturally occurring learning experience as opposed to forcing a context for the skill usage.
- Offer formative assessment for learning as opposed to the summative or disjointed formative in existence.

From these recommendations, it was established that the best direction for innovative development was in the self-assessment space; self-assessment allows for the flexibility established within the recommendations and is not a path being pursued by most developers at the moment and has the potential for more innovation.

The decision was then made to create a 21<sup>st</sup> Ce. skills self-assessment app, SkillTrack!. With the knowledge that this app would be trialled in Ireland, the frame that was chosen for the 21<sup>st</sup> Ce. skills was that used by the National Council for Curriculum and Assessment (NCCA) for the junior cycle (lower secondary education catering to ages 12-15 years). At the time of app creation, these skills, termed the Key Skills, and used interchangeable with the term 21<sup>st</sup> century skills in this paper, included Collaboration, Communication, Creativity, Information Management, and Self Management. However, the pedagogical frame and the gamification framework are not limited to this setting and have been designed to be as generic and extensible as possible.

## Gamification Framework

### Framework Overview

This section will describe and explain a gamified system for the aforementioned pedagogical design, mainly focusing on a proof-of-concept tablet app. The system consists of a tablet app, and a group of players who are students. The system was designed and deployed using the 6D Gamification Design Framework (Werback 2012).

Overall, our gamification framework suggests the design of a finite game, where (i) mastery, ownership, and identity are the chief motivators, (ii) there are clear tasks as victory conditions, (iii) levels of difficulty, levels, rewards (badges), reinforcement through teacher validation of the badges, and quests (exemplars) are the game mechanics, (iv) and status, achievement, and feedback by the teacher are the social interactions (Figure 4.1).

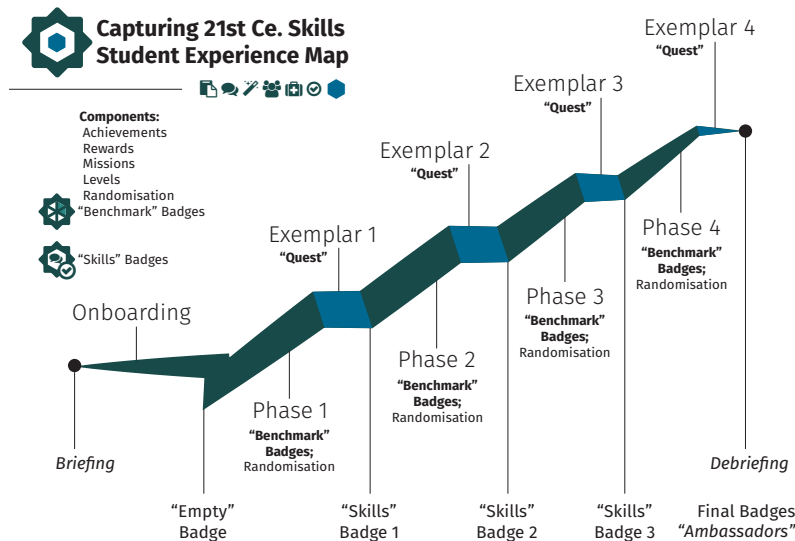


Figure 4.1: Overview of the interaction process showing the debriefing component

Our framework in this case consisted of one onboarding phase and four skill-capturing phases. The onboarding phase is content based, in the sense that it provides context for the players to learn about the skills. Then, each phase starts with the students identifying that they performed an action that has attributes of a skill; e.g., they solved a maths problem in a creative way, so they chose “Creativity”. The gamified app progresses through pedagogical questions, e.g. “Why is this a good example of Creativity?” and the player is able to track progress. The questions get more difficult through the phases. At the end of this phase there is a special quest as a condition for moving to the next phase: the players have to upload evidence (an exemplar) of an actual artefact and self-assess it according to the answers they gave at previous questions. The teacher verifies that the artefact is the player’s original work, but does not evaluate it, as for this age group the pedagogical framework suggests self-assessment. The end of the artefact uploading quest finishes with the reward of digital badges to the students. The interaction design is based on microinteractions and is beyond the scope of this paper (Kapros and Kipp 2016).

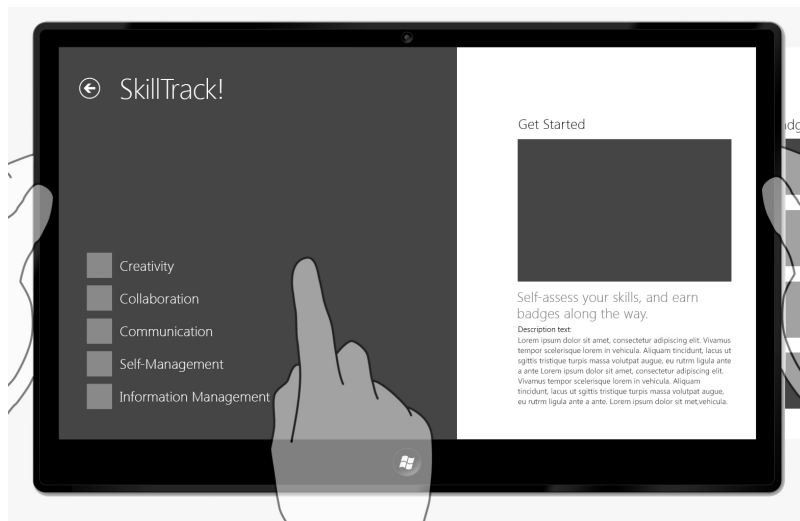


Figure 4.2: Home screen of SkillTrack! where tracking/tagging takes place

### The SkillTrack! Application

SkillTrack! is a learning application for a tablet device that brings together several technologies and is designed to make learning more interesting and effective for students by supporting the practice, development and self-review of 21<sup>st</sup> Century/Key Skills.

Generally, SkillTrack! is a student-led curricular app that runs simultaneously to teacher instruction (and includes a Teacher Dashboard component). While in class, students have the app up and running and when they think they have used one of the skills to complete a classroom task, they hit that skill’s button on the homepage. This may be done during classroom transitions or at the end of class (Figure 4.2). In response to the student hitting the skill, the app acknowledges the student’s input with a thumbs up or a benchmark task such as a quick answer question appears regarding why the student has just hit that skill (see Figure 4.3). After the question is answered, the



student returns to the homepage to continue tracking skill usage through the class and their school day.

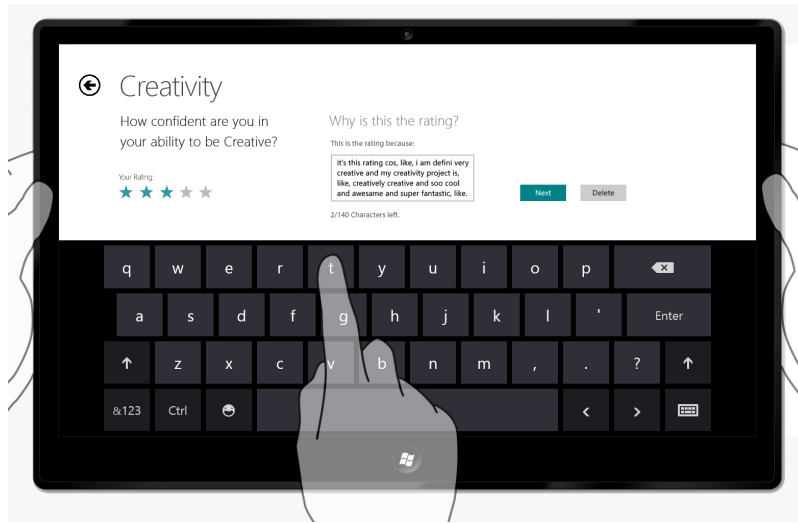


Figure 4.3: Example of a benchmark checkpoint

To familiarise students with the skills and the type of self-reflection that the app requires, the app has an onboarding phase that is teacher-led and comes before the students begin tracking their skill usage. This onboarding phase reviews the skills, asks for the students to think about what the skill is, when they use it, what being excellent in it looks like, how they would define it and how they would rate themselves in their ability to do it. Once onboarding has been completed for each skill (either in class or at home – the recommendation is for the teacher to model at least one of the skills), the app is active for tracking.

In tracking, students encounter up to four phases. A phase consists of a series of tags or tracks by the student, the answering of intermediate quick answer questions, and an outside of class exemplar stage. Once the student has completed the interactive classroom portion of the phase (which can be tracked by the filling up of the badge next to the skill on the homepage) the button for the skill will change to notify them that they are entering the exemplar stage. This stage of the phase is done outside of class and is where the students reflect on their work and ability, providing (see Figure 4.4).

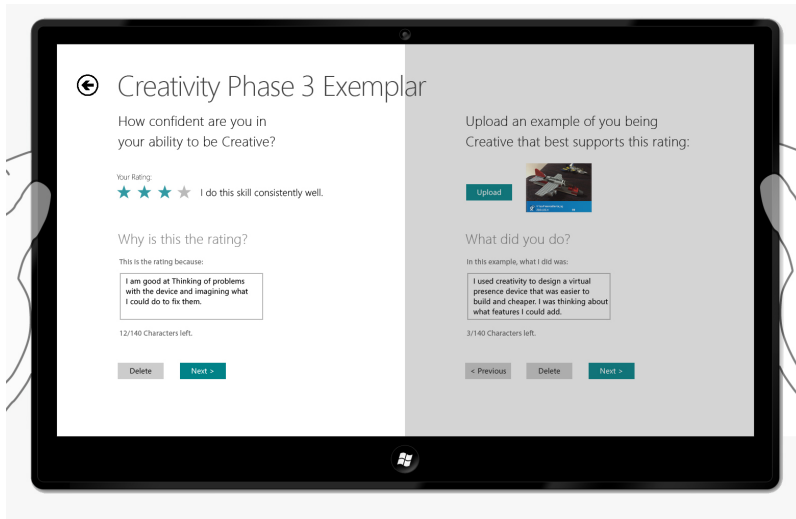


Figure 4.4: Example of a quest: upload an exemplar of your own work

At the end of the exemplar stage, the student receives a badge (upon teacher approval via the accompanying teacher dashboard where student progress is being recorded and can be monitored by the teacher) (Figure 4-5 and Figure 4.6). A student is unable to move on to the next phase until every skill in the previous phase has been completed.

The pedagogical frame in this use case is based on assessment strategies for self-directed learning and utilizes the conceptual design of manage, monitor and modify in regards to student behaviour around the Key Skills. To support this, the steps of each design phase have been built using a blend of feedback spirals and metacognitively scaffolded prompts that are designed to activate experiential learning (using Bloom's (2000) revised taxonomy, Wiggins & McTighe's (2005) 6 Facets of Understanding, and Zimmerman's (2013) Phases and Subprocess of Self-Regulation). In regards to the specific self-assessment activities, benchmark tasks are based on Rolheiser's (1996) growth scheme for teacher implementation of stages of student self-assessment and student self-rating is done using a modified version of Marzano's (2006) 4-Point Self-Assessment Scale.



Figure 4.5: Home screen menus provide easy access to rewards (badges)



Figure 4.6: End-of-task certificates provide status recognition to students

## Preliminary Findings

We have sense-checked the pedagogical framework and the gamified design with a small sample of teachers and students. The sample consisted of 3 teachers, one in NY, USA and two in Ireland, with approximately 30 students each. The response was positive and our design has been described by these few teachers as “filling the gap” in the area of skills assessment. The students perceived that they would benefit in raising their awareness around the skills. The response was from a small sample and to present conclusive findings a trial should be conducted with a prototype software application.

These preliminary findings rely on the qualitative data collected from focus group interviews with student and teacher participants.

Specifically, the pedagogical structure being evaluated consists of the design elements and activities as follows:

The pedagogical design elements (premise) of SkillTrack!

- Vertical (grade) and horizontal (subject) mobility
- Not activity specific (activity agnostic)
- Integrates into authentic classroom dynamic
- Activate student literacy
- Experiential learning
- Formative assessment
- Transformative Technology

The main pedagogical activities within SkillTrack!

- onboarding
- skill tagging,
- benchmarking tasks
- exemplar stage (exemplar + self-assessment)

When considering both qualitative data sets, and the preliminary findings and conclusions of each, there are some clear parallels that allow for preliminary conclusions in regards to both the pedagogical design elements and activities.

The design element with the strongest support from both the students and the teacher was that of *Activating Student Literacy* with both groups providing unsolicited positive comments around their experience of this element.

Other design elements to receive favourable comments included those of *Experiential Learning*, and *Formative Assessment*. Additionally, the Exemplar quest was viewed as a strong element by both the students and the teachers. Oneteacher also felt quite strongly about the *Onboarding* activity, and while no students commented on this activity, the teacher feedback was enough to view this activity as favourable (especially as it is the one activity within the app specifically designed for the teacher).

This qualitative data then would preliminarily affirm and support the effectiveness of the following pedagogical design choices:

- Activating Student Literacy
- Experiential Learning
- Formative Assessment
- Exemplar Activity

- Onboarding Activity

Two pedagogical design choices that would have received both positive and negative comments were the *Integration into Authentic Classroom Dynamic* and *Benchmarking Tasks*.

In regards to *Integration into Authentic Classroom Dynamic*, while the teacher spoke favourably about SkillTrack!'s ability to integrate into the class without interfering or interrupting, this statement was also qualified with the comments by both the students and the teachers on the need for teacher support of the app as well as a notification system to remind students to engage with the student-led curriculum.

Additionally, the design activity of the *Benchmarking Tasks* received qualified positive feedback, with both students and teacher commenting favourably on the concept but qualifying the comments with mention of the language used within the questions being too sophisticated for this age group.

This qualitative data, while generally falling into affirming pedagogical choices as the drawbacks noted were more in the articulation of the concepts than the choices themselves, would need more investigation to provide a preliminary finding or conclusion.

When considering perhaps the key pedagogical design activity, that which all other design premises and activities are leading towards, the data falls short in regards to the *Self-Assessment* activity. This most likely is connected to the main trial limitation of time and the resulting lack of students reaching this activity independently (there is an initial self-rating within the onboarding that most students would have done under teacher guidance). This meant that they did not have the experience of it so were unable to comment. It may also mean that when they did experience it, within the onboarding, that this feature was integrated well enough into the content that it was not worth noting. However, with lack of commentary on this activity, no preliminary finding can be made and further trialling would be necessary.

In considering how these preliminary findings provide suggestions for practice it can be seen that the integration of gamification strategies within a pedagogical context is appropriate and can be successful for classroom use. While this model chose to use gamification to support classroom literacy, reflection and learning, the findings of this research suggest a range of potential classroom applications particularly in the areas of behaviour management (gamified intervention strategies and plans), social and emotional learning (event identification and levelling of goal achievement questions), and problem-based learning (scaffolding and reward for early achievement).

## Conclusions

In conclusion, the original project objectives of creating a framework for the assessment 21st Ce. Skills that would be independent of (formal or informal) a singular activity and which could be implemented in a software application were met successfully.

Moreover, we have designed a gamified framework that accompanies the pedagogical design, which has the potential to enhance the user experience and the usability of skills assessment without interrupting the in-classroom activities. We have sense-checked the pedagogical framework and the gamified design with a small sample of teachers and students. These preliminary results, while generally falling into affirming both the pedagogical and the gamification choices, would need more investigation to provide a definite finding or conclusion.

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## CHAPTER FIVE

# THE DEPLOYMENT OF EXERGAMES IN THE CLASSROOM FOR THE ASSESSMENT OF CHILDREN'S LOCOMOTOR SKILLS

JAMIE MCGANN, OWEN CONLAN, LUCY HEDERMAN, AND  
INMACULADA ARNEDILLO-SANCHEZ

### **Abstract**

This paper examines the use of video games for the assessment of locomotor skills (hop, skip, jump, slide etc.). It includes a brief outline of a purpose built game to test this hypothesis with a primary focus on deployment in the classroom setting. 22 typically developing children were assessed on locomotor performance whilst participating in structured activities as part of physical education (P.E). The same cohort were then assessed whilst participating in purpose built 3D sensor controlled video games in the classroom. Findings indicate that video games support locomotor assessment in a classroom setting without compromising validity of results. In addition, video games were found to offer a unique platform to assess other useful parameters, difficult to track in 'real life' situations.

### **Introduction**

Recent studies point towards causality between poor locomotor skills (run, hop, skip, jump, slide etc.), poor academic performance (Westendorp et al., 2011) and poor health (Pica, 2008). Conversely, the modern child demonstrates decreased locomotor skill (Lam, 2011) owing to an increased sedentary lifestyle and new forms of play including online interactions and video games. Consequently, schools are expected to support locomotor acquisition by providing meaningful training experiences that target individual learner needs. This demands individual locomotor assessment, generally focused on the skill *process*. That is, identification of *criteria* the child can perform and scoring them accordingly. Skill criteria are laid out by Ulrich (2000) in The Test of Gross Motor Development – Second Edition (TGMD-2). They are illustrated in Figure 5.1 below, using the example of a 'hop'. Children score 1 point for criteria performed and receive no points for absent criteria. The TGMD-2 is used by teachers/researchers around the world. However, it can be time consuming and difficult to deploy as it requires a 'set up' of multiple activities and ultimately, only one child can be assessed at a time.

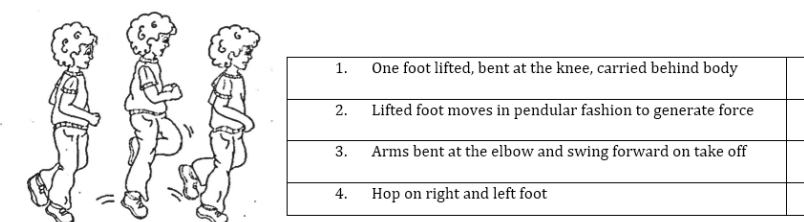


Figure 5.1: Criteria of Locomotor Skill 'Hop' illustrated by the authors, informed by Ulrich (2000)

Perhaps unsurprisingly, teachers rarely carry out locomotor assessments as they are considered time consuming and difficult to deploy (Bond, 2013). Consequently, locomotor training experiences become 'one size fits all' and fail to support individual needs or improved performance (Houwen et al., 2014). Interestingly, video games, often viewed as a barrier to locomotor acquisition, offer us a potential solution. The recent shift in game control systems has moved the domain away from sedentary finger tapping (joypad, gamepad, game controller) towards full body interactivity (Kinect, PrimeSense) (Cassola et al., 2014). A new genre of *Exergames* has emerged. Currently, affordable sensors lack an equality of accuracy for all anatomical landmarks (Clarke et al., 2012) and consequently, locomotor skills are not accurately assessed by the system on its own. However, several Exergames call upon the user to perform locomotor outputs in order to achieve game success and whilst affordable sensors cannot tell if users cheat (Gao & Mandryk, 2012), an observing teacher could. Thus, video games offer a potential platform to assess user locomotor performance as they play, in a virtual environment. The problem with this model is that teachers perceive video games to be logistically difficult to integrate and technically difficult to deploy (Fishman et al., 2014). Accordingly, there is a need to outline deployment and provide empirical evidence that supports their worth. Essentially, *how can video games be effectively deployed to support assessment of locomotor skills in the classroom?*

The next sections of this paper outlines Exergames that call for locomotor outputs from the user. It highlights technical limitations that obstruct accurate locomotor assessment by the system independently and identifies teacher beliefs as a potential barrier to the use of video games, for any purpose, in the classroom. The next section presents a purpose built video game, designed and developed to support the assessment of locomotor skills. This is followed by an outline of the action research approach taken in this study. The final section discusses the results and findings of our action research.

## Video Games for Locomotor Assessment

Video games are now one of the most popular children's past-times and conversely, described as a contributing factor to physical inactivity, decreased levels of locomotor acquisition and rising levels of obesity (Straker et al., 2011). Owing to negative connotations, there is a concerted effort to shift game play from mere recreation towards teaching and learning (Boutiska, 2014). With the emergence of 3D sensors, video games (Exergames) can now be utilised for physical activity. Indeed multiple studies and reviews have found them to elicit light to moderate intensity energy expenditure (Biddies & Irwin, 2010). Exergames have even found their way into the school setting as part of physical education and after school programs (Levac, 2015). However, to become a truly acceptable



tool for physical activity, video games should be capable of eliciting increased intensity. This requires improved sensor performance, particularly in terms of tracking accuracy of user movements (Barnett et al., 2011). At present, affordable 3D sensors are inaccurate when it comes to measuring joints and movements in the lower part of the body (Van Diest, 2015). Tracking is also ineffective when movements are fast, bi-lateral and shift in orientation (Xu & McGorry, 2015). All of which indicates that locomotor skills are not measured effectively during game play.

That said, a number of Exergames on the market call upon users to perform locomotor outputs as a means of game control. Figure 5.2 presents a description of ‘Jump Rope’, highlighting a virtual demonstration of a ‘hop’. Interestingly, this demonstration references accurate hop criteria outlined in TGMD-2 (Ulrich, 2000).

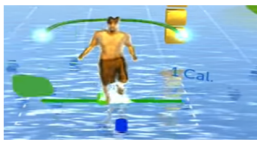
Game	Objective	Locomotor Output(s)	Demonstration
<i>Jump Rope</i> (Your Shape: Fitness Evolved) Xbox 360	A jump rope workout and physical activity based on user's current fitness level	Game involves consecutive Jumps and also calls for the user to Hop. This hop is modelled by digital character with near full criteria	

Figure 5.2: Exergame that calls for the user to hop

A virtual demonstration models a hop output (with accurate criteria) that users are expected to perform. However, user outputs are often cheated to limit energy expenditure (Gao & Mandryk, 2012). Simply moving closer to the sensor can reduce an intended hop to a basic arm lift; but children *could* be prompted not to cheat by a teacher. Theoretically, this would afford the teacher a platform to assess locomotor performance, ‘live’ in the classroom. However, in practise, video games are rarely deployed in a school setting.

Effective deployment of video games within the classroom requires an understanding of deployment which is often ignored by the literature (Herro, 2016). Teachers are not provided with appropriate support beyond ‘understanding’ the technology (Kim et al., 2013). In addition, a majority of teachers today demonstrate negative attitudes towards the use of video games in school and there is resistance to their use (for any purpose) (Fishman et al, 2014). Negative teacher beliefs predominantly centre on the fact that video games are logistically difficult to deploy and technically difficult to implement (Fishman et al., 2014).

Thus, the following section briefly outlines the development of a purpose built video game, designed to support locomotor assessment and facilitate deployment in the classroom.

## Hop Ball

‘Hop Ball’ was built using Kinect2Scratch (Howell, 2011) as it supports instant adaption of game design features, such as target height and length of play. The user is drawn towards a specific locomotor skill (hopping) via graphic model. The child is required to perform consecutive hops to negotiate rolling basket balls. Successful hops earn points. Various levels of complexity can be supported with basic modification, i.e. rate and size of ball, which dictates speed and height of

expected hop. Figure 5.3 illustrates how *Hop Ball* elicits consecutive hop outputs from the user. Game play is initially demonstrated by the teacher who then observes user capabilities. The game strips back design features to include only those that specifically support assessment and deployment in a classroom setting.



Figure 5.3: Hop Ball, eliciting consecutive hops, supporting skill assessment

Whilst *Hop Ball* allows for skill criteria (process) to be monitored during game play, it also supports the assessment of skill outcomes. That is, how high the user can hop and how many hops they can perform before fatigue. Outcomes can be monitored via design features such as ‘height lines’ (red, yellow, blue), timer and points system (i.e. 1 point for every hop). Parameters related to the outcomes are useful for teachers when it comes to development of effective training programs. These outcomes are difficult to track during ‘real life’ assessment.

Teachers attribute non-use of video games in schools to a lack of knowledge in terms of deployment (Fishman et al., 2014). As such, an action research was carried out to identify and iterate how video games could be effectively deployed to support assessment of locomotor skills within a classroom setting. Results were intended to provide a rubric for deployment and contribute towards bridging the gap between research and practise.

## Research Approach

As a primary school teacher, the lead researcher is in a unique position to engage in a cycle of action research tracking Exergames in the classroom for assessment purposes. The cycle began with the development of a video game (*Hop Ball*), to test the hypothesis. This game was developed using ‘Scratch’ and ‘Kinect2Scratch’ (Howell, 2012), both freely available online. The research continued through to deployment of the game, followed by an assessment of ‘hop’ criteria during video game play. Ultimately, educators require practical ideas about how to deploy video games (including Exergames) in the class (Vernadakis et al., 2015) as opposed to simply learning about the technology. Consequently, a rubric to support the assessment of motor skills during game play was also developed by the authors, informed by the action research.

Two teachers assessed the locomotor skills, of 22 children aged between 5-6 years. The first teacher tracked learner performance during video game play in the classroom. That is, as the child performed consecutive outputs to achieve game success the teacher assessed these outputs using against criteria outlined by Ulrich (2000). Results were calculated before the user finished game play thus, ‘live’ in the field. A second teacher assessed the same children as they performed activities in physical education. This time, the user outputs were video recorded and assessed against

criteria outlined in TGMD-2 (Ulrich, 2000) after reviewing video footage. Thus, results were 'delayed'. Finally, a paired sample-test was employed to examine if there was a significant differences between the 'live' results ascertained during video game play and 'delayed' results ascertained from video footage of activities performed in the P.E hall.

## Results

The cohort was first assessed on locomotor performance using TGMD- 2, as they engaged with Hop Ball. Results were calculated live, during game play. The same children were then assessed using the TGMD-2 as they participated in specific activities, set up in P.E (as outlined by Ulrich, 2000). Mean scores were calculated for both assessment groups (video game & P.E hall). A paired sample t-test was adopted to analyse if there was a significant difference between the two sets of results using SPSS software (ver. 20.0). No significant difference between the two groups was noted. Variance between abilities in both groups was also similar.

Table 5.1: Paired samples t-test of total raw scores for Hop

<i>Variable</i>	<i>Video Game Mean</i>	<i>SD</i>	<i>PE Mean</i>	<i>SD</i>	<i>Max score</i>
Hop	2.6	2.0	2.5	1.9	4

From a qualitative standpoint, deployment of Exergames for locomotor assessment in the classroom was also recorded. This deployment comprised of two parts; (i) set up and (ii) assessment procedures. The process was notated and the following steps outlined. Step 1, set up, is outlined in Figure 5.4.

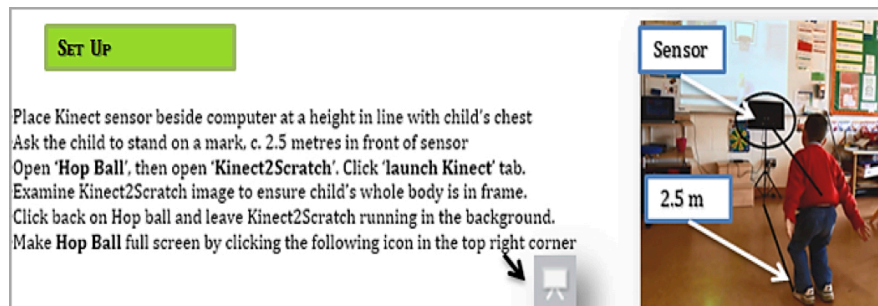



Figure 5.4: Deployment of Video Game in Classroom (Setup)

Children perform consecutive hops during game play which facilitate the assessment of skill criteria outlined in the TGMD-2. Other parameters of performance (not accounted for by the TGMD-2) can also be evaluated, namely (i) force (height of hop) and (ii) fitness (number of hops before fatigue). These parameters are tracked in a video game environment by monitoring game

design features such as the ‘timer’, ‘score’ and ‘height lines’. Results of the user’s skill criteria, force and fitness can be utilized to cater a training program that meet the *individual* needs of the learner. The following rubric for assessment (Figure 5.5) was developed by the authors over the research period to support the locomotor assessment during game play.

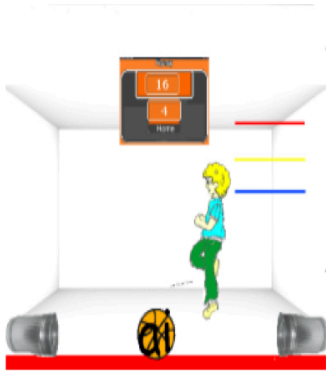
**ASSESS PERFORMANCE LEVEL**

**Hop**



**CRITERIA**

Skill Level	One foot lifted, bent at the knee, carried behind body	
	Lifted foot moves in pendular fashion to generate force	
	Arms bent at the elbow and swing forward on take off	
	Hop on right and left foot	

**HEIGHT**

Outcomes	Look at height of Hops, on average are they?	
	Low (head reaches blue line)	
	Moderate (head reaches yellow line)	
	High (head reaches red line)	

**FITNESS**

Outcomes	How many consecutive hops before player presents as exhausted? Check score.	
	How many seconds have passed? Check timer.	

Figure 5.5: Rubric to support locomotor assessment during video game play

## Discussion

Findings indicate that Exergames provide an effective platform to assess locomotor skills as there was no significant difference between results obtained through traditional assessment and results ascertained during video game play. Additional findings indicate that video games also provide a platform to assess locomotor outcomes including force and fitness, parameters that are difficult to measure using normal procedures. Real life activities carried out in P.E supported a limited repetition of locomotor skills, making it difficult to capture accurate results ‘live’. Indeed, standard practise is to video record trials and score the learner upon review of the footage. In contrast, video gaming supported a longer sequence of locomotor skills and thus, more opportunity to assess criteria ‘live’ in a *virtual* field. Video games also have clear purpose and rewards not apparent in activities laid out by TGMD-2. This increases the child’s motivation and effort,

supporting a true reflection of motor capabilities. Video games are thus, an effective platform for locomotor assessment.

Video games were also noted to be effectively deployed without significant difficulties. Further, the video game in this study was developed using Scratch and Kinect2Scratch, both freely available tools which mean the only 'cost' involved for teachers is a Kinect sensor. This sensor is portable and mobile, meaning it could be shared across many classes and many teachers in the same school. The Kinect sensor has limitations however. For example, it will pick up movement of any child in its path and therefore requires 'space'. Consequently, there needs to be adequate room in the class to allow a child to participate without other children encroaching on the sensor beam.

### **Conclusion**

Video games offer teachers a platform to assess locomotor skills in an enhanced way that is faster and supports assessment of parameters (fitness and force) difficult to measure in real life scenarios. However, teachers often hear about 'what video games can do', without being given practical ideas to support deployment. Thus, we recommend that video games designed for use in the classroom be accompanied by an outline of the deployment process. This will help bridging the gap between research on what video games can do and the practise of delivering them in the classroom.

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## CHAPTER SIX

### PILOT TRIALS OF GAME-BASED SUSTAINABLE EDUCATION

MAJA PIVEC, DARRAGH COAKLEY AND ROISIN GARVEY

#### Introduction

The Green Games project (<sup>1</sup>) focused on the promotion of sustainable development education, both for the well-being of the citizens of our world and also for the development of the economy. The central aim of the Green Games project was to develop an online digital game and game-based-learning methodology for the understanding and implementation of knowledge, skills, strategies, tools and regulations related to food and water waste and energy management specifically within the Tourism and Hospitality sector.

The Green Games project developed an applied game ("the Green Hipster Hotel"), offering an immersive, manipulable environment for education, which allows for the tuning of the learning content to the relevant learning group. The game in addition advocates attitudinal change and endorsement of relevant environmental values (Arora & Itu, 2012). The game is available for download free of charge from the Google play and iTunes stores.

By meeting guest demands and managing their available resources, players can grow their hotel effectively, constantly improving its size, capacity and reputation (Coakley et al, 2015). For further implementation of education on sustainability, the developed game also provides training on the implementation of specific equipment, practices and opportunities related to food, water and waste management. This is facilitated through the provision of in-game animated content that is focused on the specific practice/ equipment being implemented (e.g.: swapping standard light bulbs in a bedroom for energy-efficient light bulbs, or training staff on the correct way to separate waste in the kitchen). Each of these educational animations also involves a series of assessment questions, which the player is required to answer to demonstrate learning. This animated learning content and associated assessment elements are offered as a form of "gamification" within the gameplay environment in order to incentivise learning within the game. Within the game, players can speed up the process of building new rooms, upgrading existing rooms or accessing new in-game features

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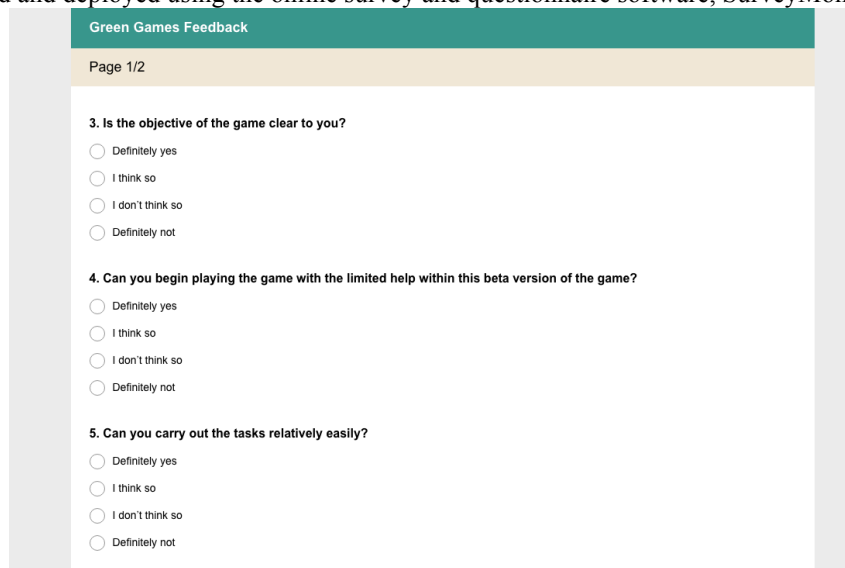
<sup>1</sup> <http://greengamesproject.com>

by engaging with this additional educational material. By viewing animated training material and by successfully answering the accompanying assessment elements, they receive in-game rewards much quicker than through standard gameplay. This process is an attempt to leverage "freemium" gameplay techniques used in popular commercial games such as "Hay Day" and "Clash of Clans". While in these popular commercial games accessing new features or speeding up processes requires paying real-world currency via in-game micro-transactions, the Green Hipster Hotel replaces this monetary-based facility with educational activities in an attempt to incentivise learning.

In addition, several possible applications of the use of the game for educational purposes are provided along with the developed game, primarily focused on three steps: preparation, playing, and debriefing (Pivec, 2011; Thackray, 2010). In the "preparation" phase, topics and their importance are outlined along with learning goals. The "playing" session can be carried out as part of the class activities, or as additional homework, or a combination of in class and after class activities, following the inverted classroom pedagogy. In the "debriefing" phase the in-game experiences need to be related to and transferred to real life context. To support better learning and discussion in this phase, students can also be asked to prepare for this phase in form of written reflections and play experience journal (Checa Romero et al, 2014).

## Piloting Methods

Extensive piloting was carried out in early summer and autumn of 2015 in Austria, Spain and Ireland, with most intensity late September, October and early November. An online questionnaire was created and deployed using the online survey and questionnaire software, SurveyMonkey.



The image shows a screenshot of an online questionnaire titled "Green Games Feedback". The page is labeled "Page 1/2". It contains three questions, each with four radio button options: "Definitely yes", "I think so", "I don't think so", and "Definitely not".

**Green Games Feedback**

Page 1/2

**3. Is the objective of the game clear to you?**

- Definitely yes
- I think so
- I don't think so
- Definitely not

**4. Can you begin playing the game with the limited help within this beta version of the game?**

- Definitely yes
- I think so
- I don't think so
- Definitely not

**5. Can you carry out the tasks relatively easily?**

- Definitely yes
- I think so
- I don't think so
- Definitely not

Figure 6.1: The online questionnaire

Twelve questions were formulated addressing demographic data, feedback on the look and feel of the game, game play and on potentials of learning by means of the game (Krug, 2014). These included:

1. The general profile of the participants in terms of what they do (student/ professional in tourism and hospitality, teacher/ trainer, etc.)
2. The general age group of the participants
3. Whether the objective of the game was clear to the player
4. Whether the player was able to play the game with the limited help available in the iteration being used for piloting
5. Whether it was possible for the player to carry out the tasks involved in the piloting with relative ease
6. Whether the player felt that they need more feedback within the game to adapt their gameplay
7. Whether the player found the game fun to play
8. Whether they player liked the visual style of the game
9. Whether the player found the game engaging and/ or interesting
10. Whether the player feels that the game has potential to teach about environmental issues in a hotel
11. Whether the player would be interested in using the game to develop skills and knowledge in the area of food, energy and water waste in tourism and hospitality
12. Whether the player would like to play a fully developed version of the game.

Additional free text fields were available to allows participants to provide suggestions for future developments to be added to the game, as well as any additional comments or observations about the game. The questionnaire was available in German, English and Spanish, and was embedded in the game. After viewing the in-game tutorial and subsequently playing the game, the players were able to provide feedback directly via their mobile devices. In total 445 responses were obtained and collated. 90% of the participants who completed the survey were students. 47% of the participants were aged between 14 and 20 years, with 44% aged between 20 and 30 years.

Four research sessions were conducted with students in Spain and Austria through in-class observation of the students as they were playing the game. For these sessions teachers would first get supporting material which included information on the topic and introductory slides detailing the game for the session. During the session game testing was facilitated by means of tablets and on-site support if necessary. The external observer documented problems and observations of student interaction with the game. After the game play, there was a discussion and debriefing session with students. Student feedback was also collected by means of the questionnaire. Feedback from teachers was obtained by means of semi-structured interviews.

In addition to sustainable education subject matter experts, an evaluation of the pedagogical context and use of the game-based resource was carried out in a workshop with high school teachers. After an introduction to the teaching material, teachers were given approximately 20 minutes to play the game and to develop a first impression of its style of gameplay, pedagogical approach, and so forth. Teachers were then spilt into groups and were encouraged to discuss the pedagogical context and the potential use of the game and accompanying resources in the classroom - focusing on potential applications of the game, knowledge transfer, and skill requirements of the teachers to implement the game.

## Results and Discussion

For more than 80% of the participants, the goal of the game was clear, and 66% could start playing the game with very little to no introduction. Around 23% of the German participants had some problems with solving the challenges and tasks in the game, whereas only 7,6% of English speaking participants experienced difficulties with carrying out tasks. 62% of players were convinced that game had the ability to teach environmental issues, and 34% were sure of the potential of the game to teach these issues. 46% of participants would like to use this game to develop their skills and knowledge in the area of sustainable development, 75% of participants would like to play a fully developed version of this game. 48% would need more feedback within the game in order to adapt their gameplay. The majority of players agreed that the game was engaging (44% -definitely yes and 48% - I think so) and only 10% of players did not like the game graphics.



Figure 6.2: The game graphics

More than half of the surveyed participants also provided their suggestions in an open comment section. Their input was clustered into four groups: (1) Orthography, grammar & wording, (2) View & resolution, (3) Functionality and (4) Other.

Comments related to the category (1) mainly referred to spelling mistakes, though 22 of the respondents also stated the German translation could be improved to be more coherent and understandable.

Findings related to the category (2) found when using the iPhone 4S only a small part of the screen was used to display the game. On some tablets videos were pixelated and when the game was displayed on smart phones it was difficult to play. Furthermore the text was sometimes blurred and

often it was not possible to read the text within the videos or the game when displayed on the smart phone.

Regarding the functionality (3) many players expressed that it should be possible to shift and turn rooms or other elements within the game (houses, properties, corridors...). Further suggestions for improvement were faster loading time, overall faster gameplay and a return button.

Other suggestions (4) were at times contradicting. Some players outlined that they would like to skip the tutorial, others commented that they would like to have more tutorials. It was also noted that it was very annoying to watch the whole video again after giving a false answer to the question. However, there were requests tabled for more in-game information about environmental problems, especially related to the tourism sector and more scaffolded feedback throughout the game.

From the gaming perspective players stated they would like to have more possibilities to develop the surroundings and the whole scene by adding shops, pools, characters, furniture or accessories and animals.



Figure 6.3: Build room

Results from the teacher semi-structured interviews offered some important insights. These participants would have liked to have explored the game in detail, or at least have tried the game out prior to the session, to be able to determine if the learning goals and objectives, i.e. that their students are gaining sufficient knowledge of food, water and energy waste reduction and sustainability to make informed decisions, could be achieved with the help of the game. Some teachers also pointed to a need for assistance in operating the mobile device required to play the game and installation of the game if necessary. The teachers pointed out that it is difficult to find games that can be integrated successfully within the curriculum in order to meet the learning objectives of particular subjects, in this case related to sustainability education. The teachers also opined that games should have a fun element to them, otherwise students won't play them.

During the discussions in this teacher workshop some additional, more general, comments were gathered related to the use of games in an educational context. The teachers noted that the goals of

the game need to be clear and how these learning goals will be evaluated in the game, or through the game needs to be communicated to students in advance of using games in the classroom. The teachers acknowledged that games help students to discover the relationships between basic principles, to allow them to figure out how things fit together thus helping them to achieve deeper learning rather than just learning to pass the test. The discussion also led to suggestions for better integrating games in the classroom - knowledge transfer can be facilitated with discussion about a game in preparation for the gameplay session and in a debriefing session after the gameplay, and students could also reflect about their gameplay and achieved learning in the form of an essay or learning diary.

Additionally, it was noted that in primary and secondary school settings, it can add to motivation if games allow for competition, either between individual players, or between students competing as class or even as a school (while remaining cognisant that competition such as this can be demotivating for weaker students).

## Conclusions

The project has drawn on a wide range of expertise in developing the game, including ecology and sustainable development, business management, hospitality and tourism studies, game design and development, instructional design, user experience and e-learning. In addition to the challenges of creating a game that is both fun and educational the project has faced the challenges typical of a multidisciplinary project, including attitudinal resistance, differing work and research methods and related communication barriers. Piloting still showed different acceptance of the game and game-based learning, related to the age and technological affinity of the players and teachers. Based on observation and feedback obtained by questionnaires, the game-play and interaction principles were clear and very intuitive for the target audience 16-18 years or younger players. Teachers generally required an introduction to the context of the game and the gameplay, as well as support, to be able to effectively use the game and resources in the classroom.

Importantly, these teachers agreed that games designed for learning should be challenging, they should allow to find new angles, explore and try out different cases. For better learning games need to provide specific details, scaffold feedback and include repetition so students can, based on trial and error, check changes of their concepts, beliefs, strategies and how these influence their performance and outcome in the game. To foster deeper learning, it is also important to integrate self-testing and evaluation tools that help players to reflect upon how one could perform better and achieve aspired results.

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## CHAPTER SEVEN

# A SURVEY OF DIGITAL GAMES USED IN IRISH SCHOOLS: THE DRILL AND PRACTICE HAS TURNED DIGITAL

MARIANA ROCHA, BRENDAN TANGNEY AND PIERPAOLO  
DONDIO

### **Introduction**

Widespread studies show learning through games stimulates students' engagement, motivation and enthusiasm. Moreover, games could improve abilities like information assimilation and retention, motor coordination, and capacity of thinking quickly and concentrating (Koh et al., 2012).

While previous surveys have showed how digital games are commonly used as educational tools, the present study aims to analyze the features of the digital games that are being used. To this aim, we first developed a survey to collect a list of digital games used in Irish classrooms. Then, those games were classified by means of a framework developed by the authors, considering technical features, the target audience and the pedagogy behind the digital game.

### **Literature Review**

According to Ke (2008), computer games have been proposed as a potential learning tool by both educational researchers and game developers. However, it is important to reflect on which type of game is really effective as a support for students to conquer academic achievements. Lowrie and Jorgensen (2015) affirms that, although there are game design features that promote higher-order thinking and deep learning, most commonly educational games are drill and practice. It means these games "simply replaces the repetition of a standard worksheet or textbook page with some added animation and colour" (Attard, 2013), and consequently lose their innovative potential as learning tools.

Research about digital games for education needs to consider different stakeholders, such as students, parents and teachers. To identify the amount of teachers that are adopting games as learning tools, some researchers invested in surveys, such as the one made with 528 European teachers which shows that 70% of them use games in the classroom (Wastiau, Kearney & Van den Berghe, 2009).

After measuring how digital games are often used in the classroom, a second question is to understand what type of games are used, and analyze the features of such games that might influence the learning experience. According to Seeney & Routledge (2009), educational games need to be

underpinned by two fields of practice: pedagogy and game design. It is also necessary to look at the player's characteristics when an educational game is designed (Kiili, 2005).

Although there are others frameworks developed to classify educational games (Ratan and Ritterfield, 2009; Rooney, 2012), they focused mainly on design features, while our model highlights the necessity of putting together three main points: the technical features of the game, the player's characteristics and the pedagogy behind the game design.

### **Methods**

We started by spreading an anonymous survey among teachers that work in schools from 22 Irish counties. They were recruited through online social media and email. The survey was designed around previous works by (Koh, 2012; Proctor and Marks, 2013; Fishman et al., 2014). In the context of this work, the aim of the survey was to quantify how many teachers declared to use digital games as educational tools and collect a list of games used. The games collected were classified by applying an original framework developed by the authors, following similar accepted frameworks developed in other learning contexts (Prensky, 2001; Patten et al., 2006; Ratan and Ritterfield, 2009; Rego et al., 2010; Wang and Sun, 2011; Konert et al., 2013). By applying the framework to the list of collected games, we both validated it and provided a structured way of analyzing the core features of each game, including features such as the pedagogical theories underpinning their design, the type of interactions between players, technical aspects and so forth.

### **Findings**

This section shows the results of our research. Until the time this paper was written, our survey had 82 answers. We excluded nine answers because the respondents do not work in Irish schools, resulting in 73 valid participations. We found that 61 of the responders use educational games (around 84% of all the answers). Most of them teach to I-IV years of primary school (62%). The following table shows the number of respondents according to their classrooms' level of education (Table 7.1).

Table 7.1: Number of respondents according to the levels of education they work with

<b>Classroom's level of education</b>	<b>Number of respondent teachers</b>	<b>Percentage</b>
<b>Primary (only I – IV years)</b>	38	62%
<b>Primary (only Infants)</b>	7	11%
<b>All levels</b>	5	8%
<b>No response</b>	5	8%
<b>Secondary</b>	4	7%
<b>Primary (Infants and I – IV years)</b>	1	2%
<b>Special Education</b>	1	2%
<b>Total</b>	61	100%

Our survey is still in a small scale, but, even though, these preliminary results suggest that Ireland may be ahead of the existing earlier survey of European teachers, which found how 70% of European teachers use games in the classroom (Wastiau, Kearney & Van den Berghe 2009). This is also ahead of the United States (40%, Proctor and Marks, 2013) and Singapore (58%, Koh, 2012).

We also questioned what digital games the respondents use in classroom. The question was answered by 46 participants. Some of them cited digital tools not considered games, such as eBooks and social networks, or gave general answers, such as “iPads apps” or “Maths games”. To clean the data, we filtered the list of answers and gathered games that could be played by us in order to apply the developed framework. For that, we used the following inclusion / exclusion criteria (Table 7.2).

Table 7.2: Inclusion and exclusion criteria for teachers' survey answers selection

<b>Inclusion criteria</b>	<b>Exclusion criteria</b>
Only games or gamified digital tools	Other cited tools such as eBooks, music making digital tools, software used (e.g.: Scratch) to develop games etc.
Games / gamified digital tools with specific names that allow us to identify the one used by the participant	Too generic games (e.g.: “word search”, “battleship”, “scrabble”) for which multiple different versions might exist

The final list of games had 24 distinct items, which were evaluated through our framework. The framework we developed, depicted in Figure 7.1, covers the technical, pedagogical and target audience features of a game; we briefly explain them as follows:

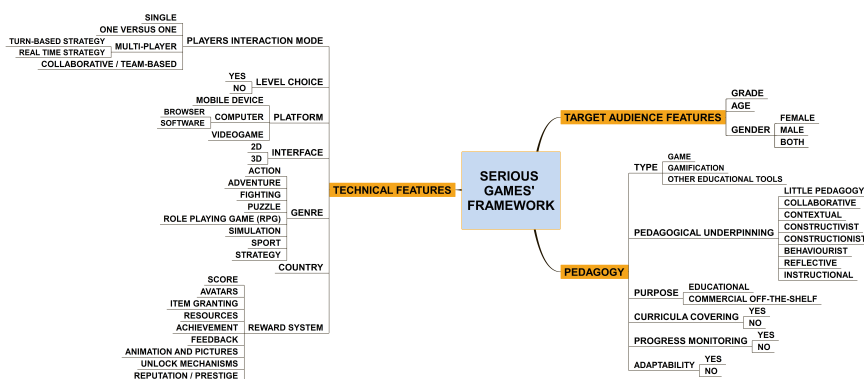


Figure 7.1: Serious games' framework.

- 1) **Technical features:** this category classifies the specifications of the game, considering the interaction among players; the possibility to choose the level of difficulty of the game; the two or three-dimensional platform; the genre; the country where the game was developed; and the reward system used.
- 2) **Target audience features** consider the features of the players to whom the game was developed, determining their grade, age and gender.
- 3) **Pedagogy** categorizes what are (if any) the pedagogical intentions behind the game. It considers if the game is a proper game, a gamified tool, or another educational instrument. It also considers the pedagogical underpinning the game; if the game is developed for education or is commercial off-the-shelf; if it covers curricula content; if it is possible to monitor the player progress on the game; and if it adapts its difficulty according to the player progress.

We now present the most meaningful results of the application of the framework to the games cited by the survey's respondents. We found that, 92% were played in a single player mode. None of the games were collaborative / team-based. Most of the games (58%) could be played online in a browser, but we also found that 54% of the total number of games could also be played in a mobile device. Around 92% of the games had 2D interface. Most of the games were developed in the United States (38%) and only one game was created by an Irish company. About the reward system, it is important to remember that one game can use more than one reward system, rewarding the player, for example, with scores and feedback. The most used reward system was Score, present in 42% of games.

We also evaluated the games according to the levels of education in Ireland. Although many games do not specify what should be the school level of the target audience, 25% of them were made for Senior infants students. It is interesting to highlight that none of the games seemed to be developed for girls or for boys: all of them would be appreciated by both genders. Around 79% of the tools cited by the respondents had real game features, while 29% were digital tools with some game mechanisms (gamification).

Considering the pedagogy behind the evaluated games, 83% of them were behaviourist, 13% were constructivist and 4% had little pedagogy behind them. This result matches with the genre category: 83% of the games were also puzzle type, which means that the majority of the evaluated games are drill and practice. Besides, most of games were developed with educational purposes (75%) and 63% of them covered the curriculum. Only 17% of them had progression monitoring, allowing the teachers or parents to follow the student evolution. Finally, only 4% of the games had adaptability features, which means that it identifies the individual capacities of the player and, according to this, changes the difficulty of the gameplay.

## **Discussion**

Our aim was to analyse the features of digital games and gamified tools used by Irish teachers for education. We considered three main fields of analyses: the technical features of the game, the target audience features and the pedagogy behind a digital game. Regarding the technical features of the game, we found how the large majority of the games are designed for the student playing alone. A partial justification for this lack of interactions could be found in the additional complexity required to build interactive games. The idea of using computers and games to implement a collaborative learning experience is well acknowledged by researchers, but in order to implement this strategy it is necessary to face challenges such as the adaptation of learning content and the management of more complex interactions between players (Wendel et al., 2012).

Most of the evaluated games are puzzle type and have behaviourist pedagogy behind them. Although many educational games claim to underpin their design in constructivist learning theories (Rooney, 2012), it seems that the digital games used to support education in schools are visually appealing drill-and-practice games, confirming the observation by Lowrie and Jorgensen (2015). This result deserves further investigation. It could suggest that the set of available games is still limited to drill and practice games, evidence of a low level of maturity in games design; or it could reflect an obstacle to adopt more interactive games in the learning environment.

About the audience, it was satisfying to perceive that all of the games were developed for both genders. Vermeulen et al. (2014) affirms that “gaming itself concerns a gendered leisure activity” and says that the games’ industry has been favoring boys instead of girls, which doesn’t seem to be the case in educational games.

## **Conclusion**

In this paper, we analysed the status of the digital games adopted in Irish schools. We provided an insight about what teachers believe to be efficient games for learning and we presented a framework to critically classify games. The framework allows classifying the technical features of the game, the target audience and the pedagogical theories that underpinned the game, making it easier to understand how and for what those games could be included in the learning process. Our main results were that digital games are dominated by drill and practice games with few exceptions. Behaviourism is the most used pedagogical theory underpinning games' design, and the majority of games are single-player with no interactions or collaboration between players. Starting from this result, our future works will include face-to-face interviews with teachers in order to better investigate the perceived benefits and barriers in using games for learning, especially to better understand if there are barriers limiting the usage of more interactive and collaborative games.

## **Guidelines**

Studies of learning games started in the end of 20th century, getting stronger in the last few years. However, it is hard to find the best way of evaluating the power and the efficacy of a digital game for learning. In this study, we provided a framework to classify games that could be used by researchers and practitioners in the area. We believe that using a framework to classify the existing educational games is a first step to comprehend the relationship between games and their efficacy for education.

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## CHAPTER EIGHT

# POCKET CODE: A MOBILE APP FOR GAME JAMS TO FACILITATE CLASSROOM LEARNING THROUGH GAME CREATION

BERNADETTE SPIELER, CHRISTIAN SCHINDLER, WOLFGANG SLANY, EUGENIA BELTRAN, HELEN BOULTON, EUGENIO GAETA AND JONATHAN SMITH

### Introduction

Game jams are a way to create games under fast-paced conditions and certain constraints (Eberhardt, 2016; Deen, et al., 2014). The increase in game jam events all over the world, their engaging and creative nature, with the aim of sharing results among players can be seen in the high participation rate of such events (2013: 16,705 participants from 319 jam sites in 63 countries produced 3248 games) (Fowler, Khosmood and Arya, 2013). This promising concept can be easily transferred to a classroom setting.

Academic game jams are a kind of project work that fosters collaboration and at the same time results in understanding learning content from different subjects (Chandrasekaran, et al., 2012). Tools normally used in professional game jams (Suddaby, 2013), like the game engine Unity3d<sup>2</sup> or the computer graphics software blender<sup>3</sup> are either difficult to learn for young students or not available in schools. This paper argues that Pocket Code, a mobile app enabling one to program games within minutes, is easy to learn even for novices, and is applicable to different academic subjects. It seems to be a perfect tool for game jams. Children nowadays grow up with mobile devices, and feel comfortable using them. Considering the current prices and the forecast of the user penetration for smartphones in Austria, France, Germany, and the United Kingdom from 2014 to 2021 (Statista Market Analytics, 2016) as well as the difference in number of smartphone and tablet users in Western Europe in 2014 (eMarketer; February 2, 2015) and the current electronic device usage in Austria in 2016 (TNS Infraset, Google, 2016) one can conclude that smartphones will probably be used more by students in the future than the more expensive tablets or laptops. Further, a mobile app greatly facilitates research since relevant data can automatically recorded when uploading the games to the Pocket Code's code sharing web-platform (subsequently referred to as web-share).

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<sup>2</sup> <https://unity3d.com/>

<sup>3</sup> <https://www.blender.org/>

This paper presents the general setting of a game jam, explains the practice of using Pocket Code in the school context, shows the aims of the project, and highlights the first experiments in performing Pocket Code Game Jams.

### **Game Jams: An overview**

Recent studies of game jams explored the collaborative nature (Chatham, et al., 2013) in combination with improvement in self-efficacy (Smith and Bowers, 2016), identified certain guidelines (Goddard, Byrne and Mueller, 2014), referred to game jam frameworks like Mechanics Dynamics Aesthetics (MDA) (Buttfield-Addison, Manning and Nugent, 2015), or investigated the motivation of jammers and their reasons for participation (Wearn and McDonald, 2016). Until now, less attention has been given to exploring game jams within an academic context e.g., students at the high-school level.

Goddard, Byrne and Mueller (2014) have identified several game jam characteristics, e.g., appropriate team size, where teams are formed (online or on-site), audience (professional or academic), timeframe (normally ranging from 24 to 48 hours (Moser, et al., 2014), occurrence (continuous or work hours), process (open, internal, or milestones), place (e.g., co-located), awards (for games or pace), constraints and submission (digital or presentations). The essential factor to frame a game jam is to define constraints for space and scope like a given theme or additional diversifiers, e.g., a local multi-player mode or to use materials found in the public domain. These diversifiers can provide small additional sub-goals to aim for (Global Game Jam®, 2016). All rules push participants to be fast, think creatively, work collaboratively, and finish a game within a given deadline (Kaitila, 2012).

Preston, et al. (2012) characterized a typical game jammer at the most popular game jam event: the worldwide Global Game Jam (Fowler, Khosmood and Arya, 2013), which plays a significant role in research. The participants are mostly male and already advanced in various areas (knowledge in at least one programming language or game-making software), with the motivation to meet potential business partners or to sharpen skills. This fact could lead to social pressure for a novice developer. Another point (Jaffa, 2016) about common game jams notes that jam participants need their own hardware and tools to create their projects and therefore puts participants without the ability to make their own tools at a disadvantage.

By contrast, in an academic setting, game jams allow students with common goals to work together while expressing individual ideas and creativity (Chatham, et al., 2013). Therefore, game jams cover various game-making disciplines, like programming, art, and design, and support learning by doing.

For game jams with an academic purpose the theme centres mostly on school topics (Goddard, Byrne and Mueller, 2014), where factors such as learning achievement, engagement, and persistence are important.

## Pocket Code: Creating games

Tools, like Scratch<sup>4</sup> or Snap<sup>5</sup> that were designed to help programming beginners through a visual programming language are already well known and adopted in computing classes all over the world (Meerbaum-Salant, Armoni and Ben-Ari, 2010). These visual programming languages keep the focus on the semantics of programming and eliminate the need to deal with syntactical problems. Pocket Code<sup>6</sup> is similar to Scratch but it can be directly programmed on the mobile device.

It is freely available at Google's Play Store and allows its users to create games, animations, music videos, and other kinds of apps on their smartphones. Pocket Code integrates with the device's sensors such as inclination, acceleration, loudness, or compass direction. It uses a visual, Lego®-style way to put code bricks together to form scripts.

For demonstrating the functionality of Pocket Code's concise user interface, a simple Pocket Code program is developed (see Figure 9.1). The program consists of two objects (left), the two looks used for animation (centre), and the bird's script that defines its behaviour (right).

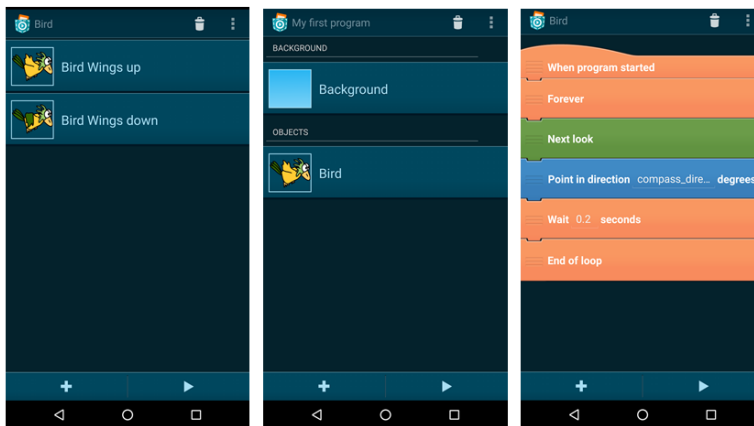


Figure 9.1: Example Pocket Code program

Every program has a number of objects and one background (which is a special object). Every object can hold a.) scripts to control the object, b.) looks, which can be changed and c.) sounds, to integrate music. The behaviour of the object and its looks and sounds can be controlled by scripts. The goal is to create a bird flapping its wings and always pointing to North, wherever the phone is pointing to.

This Pocket Code demo consists of two elements, a sky-blue background object and a bird object (Figure 9.1 (left)). The object bird has two different looks, which are used for the animation of its wings (Figure 1 (centre)). The bird's scripts section contains a single script that makes the bird flap its wings and updates the bird's direction to the North (Figure 9.1 (right)). The script consists of

<sup>4</sup> <https://scratch.mit.edu/>

<sup>5</sup> <http://snap.berkeley.edu/>

<sup>6</sup> <http://www.catrobat.org/>

different-coloured bricks, indicating their originating brick category, e.g., control, motion, sound, looks, and data. The first brick, "When program started," is a trigger that starts the execution of the script whenever the Pocket Code program is started by the user. The "Forever" brick, with its delimiter "End of loop," represents an endless loop, meaning that every brick between "Forever" and "End of loop" is executed as long as the Pocket Code program is executed. The "Next look" switches the object's appearance from "wings up" to "wings down" and the "Point in direction" brick updates the object's direction. To use the compass direction, Pocket Code accesses the device sensor through the formula editor functionality. The last brick's purpose in the forever-loop is to slow down the animation rate. Therefore, a "Wait 0.2 seconds" brick is inserted, causing a 0.2s delay in this loop.

### The “No One Left Behind” project

Pocket Code has already been validated as an effective learning and teaching tool in the ongoing European project “No One Left Behind”<sup>7</sup> (NOLB), funded by the Horizon2020 program. During the feasibility study from September to December 2015, followed by the first cycle in Spring 2016, three pilot studies in Austria, Spain, and the UK were conducted. Each pilot targeted around 200 students between age 10-17, experiencing social exclusion problems. The Austrian study is dedicated to raise girls' interest in Science, Technology, Engineering, Arts, and Mathematics (STEAM)-related subjects and fosters social inclusion in class (Craig, Coldwell-Neilson and Beekhuizen, 2013). In these ways, Pocket Code should enhance students' abilities across different academic subjects, and improve their computational proficiency, creativity and social skills.

The goals were measured in two ways:

1. Three quantitative surveys have been conducted: a pre-questionnaire before starting with Pocket Code, a questionnaire directly after the last Pocket Code unit, and a post-questionnaire about one month after the last Pocket Code unit. These surveys measured students' intention to use Pocket Code and possible barriers, differences in subgroups, gender and usability barriers related to Pocket Code. The results have been analysed via a descriptive content analysis and a user experience model.
2. The learning objectives defined by the teacher beforehand were measured against the learning outcomes. Games that have been uploaded to the web-share have been analysed towards learner achievement, collaboration, persistence, engagement, and amount of assistance/guidance needed. This data was collected through on-site observations, recorded by taking notes, videos, and photographs.

The results show that Pocket Code is easy to use (evaluation of the questionnaire) and fosters collaboration (most projects were done in groups of two), has the potential to help students' academic performance (105 out of 172 projects fulfilled the learning goal defined beforehand by the teacher), and, thus by acting as a supporting learning tool, leads to accomplishing academic curriculum objectives. Further formal assessment will be done during the 2<sup>nd</sup> cycle of the NOLB project starting in September 2016.

Beside this research, Pocket Code is a convenient tool for game creation in game jams (Petri, et al, 2015) because of its general applicability. Pocket Code allows one to:

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<sup>7</sup> <http://no1leftbehind.eu/>

- create games within a short time span in fast paced and collaborative environments.
- merge programs among peers and transfer objects, code, looks, and sounds between projects via the “Backpack” functionality and therefore fosters distributed development.
- share the collection of programs through the upload to the web-share
- participate easily. According to a survey at the beginning of the study, 179 out of 187 pupils in Austria’s pilot had their own mobile devices. For participation no costly hardware or tools are needed. This point facilitates the setup of Pocket Code game jams since there is only a minimal organization effort for teachers and schools.
- participate globally. Since Pocket Code is translated into 40 different languages, students all over the world can participate and use the app in their mother tongue. Students worldwide can be reached through online game jams and submission through the web-share.

For the NOLB project, the goals towards game jams include:

- Identifying benefits for students to run game jams in academic contexts.
- Identifying problems such as difficulties in generalizing results or missing functionality in Pocket Code.
- Holding several official online Pocket Code Game Jams to gain deeper understanding in setting up such events and discover potential obstacles.

## Game Jam Experiments and Results

The first two official Pocket Code Game Jams events were held during the European Code Week from 12<sup>th</sup> to 18<sup>th</sup> of October 2015 and during the International Computer Science Education Week from 7<sup>th</sup> to 13<sup>th</sup> of December 2015. The game jam aimed to engage female teenagers and introducing them to programming in a playful way (Ann and Comber, 2003). The theme for both jams was “Alice in Wonderland” because it seemed to fit for all genders and could be transferred to different subjects like Maths or literature. The game jams were conducted together with the MIT Scratch team. The first game jam was held using first year computer science students at Graz University of Technology. This event brought insights for the main event in December 2015 and was part of their homework. For the second game jam, 95 games were submitted (54.74% Scratch, 45.26% Pocket Code). Participants were told to fill out a questionnaire after submitting their games. (All games can be found at [pocketcode.org](http://pocketcode.org) with the hash tag #AliceGameJam<sup>8</sup>). Results show that 46.32% participants were female, and 44.21% had already some knowledge in programming languages like C++, Java or Python (13 participants), NXT programming (2 participants), in Scratch (3 participants) or Pocket Code (4 participants). The average age of the participants was 17 years. The 95 project submissions were created mostly at home (62.11%) or in schools (32.63%). Schools were encouraged to make “Alice in Wonderland” background knowledge available to students beforehand, and 75.79% of the participants mentioned in the survey that they liked the theme. The findings indicate that slightly more than half of the submissions (51.57%) were created in small teams (29.47% teams of 2; 4.21% teams of three; 17.89% teams that consisted of more than 3 team members), thus identifying the potential for enabling skills such as sharing, team problem solving, and cooperation. For these reasons, game jams in classrooms have the potential to support the

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<sup>7</sup> <https://share.catrob.at/pocketalice/search/%23AliceGameJam>

development of the children’s social and academic attitudes. Furthermore, their various talents are nurtured by building and enriching personal and collaborative knowledge, and becoming part of a wider community with different social and cultural perspectives (see submissions from different countries in Figure 9.2).

Country	Number of Submissions
Italy	31
India	20
Austria	16
Spain	4
United Kingdom	8
United States	3
Bosnia Herzegovina Canada, Egypt, Germany, Hungary, Philippines	1
didn't mention a home country	17

Figure 8.2: Number of submissions for the Alice Game Jam event per country

Almost half of the participants spent 2 to 7 days working on their programs. (44.21%) and 29.47% spent only 2 to 5 hours on programming their games. This shows that the participants were willing to spend extra time (outside of the school) to program their games. Reasons why they participated in this game jam included (multiple answers were possible): “I liked the topic” (23), “I wanted to create a game” (32), “It was part of a school/university activity” (60), and “My friends participated” (7). Surprisingly, nobody chose that he or she wanted to develop their ability to code. Only two participants mentioned that there weren’t satisfied with their outcome. The survey also showed that games were created across different school subjects like Maths, German or Chemistry (see example game in Figure 9.3). Therefore, game jams can be adapted to support learning and teaching strategies across different disciplines and obviously do not need be restricted to computer science classes.

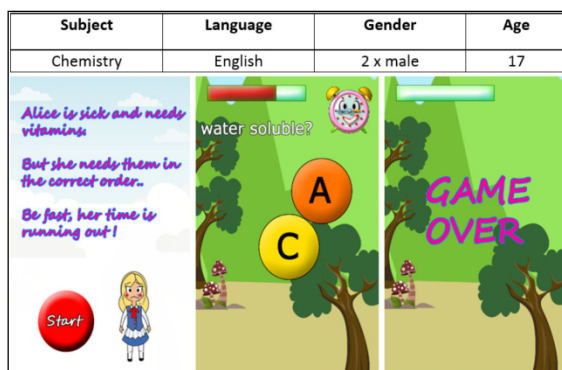


Figure 8.3: Example project in Chemistry submitted for the Alice Game Jam event with the title “Sick Alice”

## Discussion and Conclusion

This paper argues that the programming app Pocket Code can support students in their learning goals and in combination with the promising concept of game jams for project works at schools. Further jams will need to be performed to provide a more precise matrix for recording the research. An upcoming feature of the Pocket Code app will include the integration of a customize software development kit (SDK) to track events within the app to define certain learning achievements like persistence through time spent in different parts of the app. Further, the paper shows that the concept of game jams works in a school context, but some additional challenges have been identified that must be addressed before the approach gains scientific relevance.

Challenges include that voluntary participation and intrinsic motivation, are also key factors of the play in game jams (Goddard, Byrne and Mueller, 2014). In a traditional school setting most teachers see a need for assessment and participation. To motivate more schools to participate in game jams further research is planned to design game jams especially for schools by providing helpful material, tutorials, and assets like graphics and sounds during the jam.

## Future Work

Plans include a coding-for-kids’ roadshow over nine weeks on the main squares in cities throughout Austria, with morning and afternoon workshops on Pocket Code for school classes. The created games can be submitted for the Galaxy Game Jam<sup>9</sup> event in cooperation with Samsung, which will run from June until end of October 2016 (again during the European Code Week).

## Acknowledgements

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<sup>9</sup> [www.galaxygamejam.com](http://www.galaxygamejam.com)

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## CHAPTER NINE

### EMPLOYING Q-METHOD TO INVESTIGATE INFORMAL LEARNING IN AN UNDERGRADUATE GAME DEVELOPMENT PROJECT

STEPHANIE GAUTTIER, BRYAN BOYLE, CHRYSANTHI  
TSELOUDI, AND INMACULADA ARNEDILLO- SANCHEZ

#### **Introduction**

This study outlines the informal learning outcomes of students' participation in a collaborative game development project. This project was conducted as part of an undergraduate program for students of computer science and business disciplines, in which they learn how to develop technological artefacts in a realistic manner, interacting with clients and working as a team. Although the situation is part of a formal learning process and students get courses and the help of demonstrators, they also learn how to work and create the games on-the-job, in an informal manner. While learning professionals assess formal learning outcomes along the way there is little understanding on the informal aspects of what students learn and the challenges they encounter as they develop the games.

We confronted the points of view of the teaching staff and students in relation to their implicit learning during the module using Q-method. Three students, their client and their lecturer participated. The results show that the points of view of the teaching staff and students diverge. They highlight practical implications for future setting of similar tasks.

#### **Background**

The integration of game development exercises in programming and undergraduate courses is commonplace (Cagiltay, 2007). Introducing such exercises in programming courses motivates students, so they enthusiastically work harder and seek opportunities for additional learning (Becker, 2001; Jones, 2000). In software engineering specifically, many topics taught in the curriculum can be covered by games or are applicable to game development (Jones 2000; Cagiltay 2007). In the process, students can visualize their coding mistakes (Becker, 2001). As such, game development provides opportunities for informal learning within a formal setting.

Informal learning – the unstructured learning that can vary from intentionally to unconsciously acquired knowledge or skills - is recently gaining attention as learning that should be recognized and validated, but is often overlooked by educational institutions (Peeters, De Backer, Buffel, Kindekens, Struyven, Zhu & Lombaerts, 2014). Although some aspects of informal learning can be

seen as desirable by the task-giver, they cannot be fully prescribed a priori and are not assessed, nor listed, by the end of projects. One of the tasks of this study is to identify the informal learning outcomes project participants think they achieved.

Exploring informal learning is challenging: perceiving such learning outcomes is by nature subjective and qualitative approaches capturing this subjectivity are therefore necessary. It also requires careful consideration of learners and learning setting. Indeed, prior research has shown that prior experience (Cagiltay, 2007), motivations (Becker, 2001), prior knowledge and characteristics (Dochy, Segers & Buehl, 1999) may impact learning. This paper focuses on the experience of 3rd year students from the same university, with similar prior experience in team product development, and involved in the same module.

An important consideration when examining individual learning outcomes - particularly non-formal outcomes - is which specific aspects of a project the students learn about. In this case, whether they would learn about the game's content (Van Eck, 2006), computer related topics and/ or their end-users. In addition, even if lecturers assign group projects hoping that students will informally learn soft skills, it is unclear if students feel they actually gain these. Examining not just a student's subjective experience but also that of the lecturer and client is necessary in order to highlight common areas of meaning and shared representation of learning outcomes gained.

As a result of these considerations, this study was designed to address the following questions:

1. What do students feel they have learnt informally during a game development project?
2. What do people responsible for the projects' assignment think the students will learn informally?
3. To what extent do students' and teaching staff's viewpoints converge or diverge?

### **Context of study**

Two groups of 6-7 undergraduate (2nd or 3rd year) computer science students were set two different design challenges. These were related to the development of a suite of educational games, aimed at providing children with autism with opportunities to learn, develop and practice a range of social interaction skills.

The first group was tasked with building a multi-player 3D game that provided opportunities for children with autism to learn social interaction skills collaboratively. Students had to develop a multi-player game specifically designed to match the needs of children on the autism spectrum, from the user requirements to a working game prototype.

The second group was tasked with developing a multi-player motion capture game for children with intellectual disabilities. They had to create a gaming environment for children that would eliminate the need to use intellectually demanding and physically challenging interfaces such as keyboards, mice, pointing devices etc.

Each group had approximately 9 weeks to complete the design challenges set for them with the additional expectation that in the last two weeks of the project both groups meet to discuss factors and issues common to both groups. Following completion of the projects, both groups engaged in a

focus group with the researchers, aimed at reflectively examining informal learning outcomes accrued during the project.

## **Methodology**

We used Q-method to capture students' and teaching staff's perceived learning outcomes from this module. Indeed, Q-method (Watts and Stenner, 2012; Stephenson, 1935; 1953) allows capturing subjectivity. A Q-study is administered in 3 steps. First, one must generate the concourse, i.e the volume of statements available on a topic. Stephenson recommends statements are generated through focus-groups or interviews. These statements are the stimuli on which participants react to express their point of view in the second step, the q-sorting procedure. Participants rank statements in a forced distribution matrix following the shape of a normal curve, so that they can rank only a few statements as most and least representative. This forces them to make choices and express their point of view in a structured way. Finally, completed sorts are analyzed through q-factor analysis, which allows identifying the different points of view presented on a topic, their structure, as well as commonalities and differences between points of views.

In our case, the concourse was generated during a focus group about students' perceived learning outcomes. Four students participated in this discussion and generated a list of 20 different topics linked to their learning outcomes. The researchers rephrased them to capture all nuances from what the students had discussed. A final list of 35 statements was submitted to students, who validated it as representative and exhaustive of their learning outcomes.

Participants first had to split the 35 statements into three categories (agree, no opinion, disagree). Then, they had to rank the statements in a forced distribution matrix (see table 1), and answer a couple of open question on their ranking.

Table 9.1: Statements distribution in the distribution matrix

-3	-2	-1	0	+1	+2	+3
3 statements	5 statements	6 statements	7 statements	6 statements	5 statements	3 statements

Eventually, three 3rd year students, the project client and one of the lecturers of the module proceeded to the q-sort. Students ranked statements according to what they felt they had been learning, from their individual subjective point of view. The client and the lecturer filled in the q-sorts according to what they felt the students would have learnt over the project. 5 q-sorts arising from 5 individuals were included for analysis. This sample size is suitable for Q. For instance, Van Exel and De Graaf (2005) suggest the sample comprises between 4 and 6 people.

## Results

A Q-factor analysis was run on the 5 q-sorts. It yielded 3 factors, explaining 79% of the variance (see table 9.2).

Table 9.2: Q-factors and variance explained

	Factor 1	Factor 2	Factor 3
% of variance explained	32	25	22
Defining sorts	Lecturer, Client	Student 1, Student 2	Student 3

A first observation pertains to the structure of the factors identified: the teaching team (the client, the lecturer) have a similar point of view of what students might have learnt informally by working on the project; students 1 and 2, who were from the same group, share representations; student 3 represents a different point of view.

We describe the three points of view identified (a synthetic visualization is available in Appendix A).

**View 1 - Learning focused on personal learning**

The first view is driven by learning outcomes that are personal and not linked to interaction with the group. The statements rated the highest are specifically linked to Computer Science learning, covering topics related to games (+3), new tools (+3), or new topics such as gesture recognition (+3).

Other highly rated elements refer to the development of personal soft skills, such as distinguishing between feasible and less realistic ideas, identifying help resources, or handling tasks without specific requirements (all +2). On the contrary, statements highlighting learning interpersonal skills such as working in a team are negatively rated. "I have learnt to communicate with demonstrators", "I have learnt to understand different personalities", "I have learnt to work with others so that they can perform at their best" are rated -2. Finally, this view considers that students didn't learn whom to ask for help or when to ask for help (-3), and that they didn't learn to manage their time on the project.

**View 2 - Learning focused on group management**

The second view proposes a reversed point of view. It holds that the main learning outcomes were linked to managing others: delegating tasks, helping others to perform at their best, accommodate teammates' needs are ranked +3 and +2.

When it comes to learning linked to developing the games, students admit they have learnt about new tools, i.e Kinect and Unity, (+1), but they do not believe they have learnt about the types of games autistic kids would prefer (-3), nor did they learn about new topics in computer science (-3).

**View 3 - Learning focused on leadership skills**

The third point of view is the one of students who see they've learnt the most from their leading role on the project: they have learnt to deal with hierarchy, communicate with the group, and collate parts from assignments (+3). They have learnt to take responsibilities to structure the group and to solve conflicts, accommodate teammates' needs and understand different personalities. (+2). Learning to lead a team also goes with some difficulties: students didn't learn to structure teams based on talents (-3), and they didn't learn much about communicating to the outside world. Statements referring to learning whom to ask for help was rated as (-1), and additional statements such as learning to identify external help resources, when to reach out, communicating with demonstrators were rated (-2).

Learning outcomes linked to computer science or game development are not highly ranked: students don't think they have learnt to better understand the end-user (-3), they didn't learn about game design or evaluating games (-3), and learning to use new tools was seen as a neutral statement.

## Discussion

These results show an important mismatch between what the teaching staff thought the students would have learnt and what the students themselves say they have learnt from the project.

For students, it is working in a team that makes the module very specific. This emerged during the focus-group, where the first items of learning identified were linked to organizing the work, understanding teammates, solving conflicts, i.e. elements that wouldn't be found in individual projects. Yet, the teaching staff perceived the main learning outcomes to be in relation to programming skills. This may be explained as them seeing the module as an opportunity for

applying these programming skills, in contrast to other modules where students get more theoretical knowledge.

Perceived learning outcomes are different among student groups as well. The focus group showed that one group had had internal conflicts while the other one hadn't. This may explain a point of view where communication within the group was seen as the most important learning outcome, while the point of view emerging from the student of the other group is centered around organizing work.

It appears students didn't learn much about topics related to the specific task they were given. Future research should investigate implicit learning across all groups in the module to assess the weight played by the task given in shaping learning outcomes.

From an organizational perspective, it seems that students from both groups didn't know whom to ask for help. This point was mentioned in the open questions by all students. Learning and experience on the project could potentially be improved by giving more information to students about the role of external teaching staff (demonstrators, client) and about the professional developer communities they could reach out to.

## **Recommendations**

Based on these results, we identify recommendations on how to structure similar assignments best to maximize students' learning:

- Students should be aware of the role of other parties on the project (demonstrators, lecturers, clients) so that they can use their social resources best during the project;
- Evaluations should also focus on "learning to work together" rather than just on the technical specificities, as the team aspect of the project seems to be quite important to students;
- Reflective discussions should be encouraged, so that the teaching staff can identify learned items and adjust the design of the projects;
- Team dynamics can have an impact on what is learned. Some measures can be taken to ensure that all students have gained a similar basis of knowledge, for instance by encouraging them to share their experiences or accompanying projects with materials on team management within different situations.

## **Limitations**

This study is limited by the size and nature of its sample. Second year students didn't show interest to participate in the study at any point. It would be interesting to understand whether this non-participation was driven by a lack of personal reflection on what they have learnt, which would make it harder for them to articulate their learning as demanded in Q, or by a simple lack of interest in this research. Second-year students had different roles in the project than third-year students, who were in charge of the teams. Their learning outcomes could have been very different than the ones we have identified here, and potentially relate more to game-development per se.



## Conclusions

Learning to develop games in a team may lead to a wide variety of learning outcomes. While developing games may lead to improved programming skills, computer science topics, as well as knowledge related to the game's content, purpose or end users, students in this study did not perceive these as their most prominent learning outcomes. Instead, they have learnt more about working in teams and managing others. The lecturer and client, however, did not share their views. Future exploration of these different opinions and integration with a more objective assessment of the learning outcomes perceived by both students and lecturers may further our understanding of informal learning and provide guidelines that will help instructors nurture it.

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## Appendix A. Synthetic Q-sort visualizations

## View 1

-3	-2	-1	0	1	2	3
I have learnt when to reach out for help	I have learnt how to communicate with demonstrators in a transparent way	I have learnt to deal with hierarchy within the group (leading or being led)	I have learnt how to better understand the end-user (autistic kids)	I have become at presenting my work; for instance to present ideas to demonstrators, teammates, lecturers	I have learnt to distinguish between feasible ideas and less realistic ones	I have learnt topics related to games: game design, evaluating games
I have learnt to estimate what I can do in a given time	I have learnt how to communicate with the group in a transparent way	I have learnt how to communicate with clients in a transparent way	I have learnt to take responsibilities for the tasks I have been assigned	I have learnt to work with people who have different perspectives	I have learnt to identify external help resources and support (for instance online)	I have learnt new tools; for example, using Kinect 2.0, unity 3D
I have learnt whom to ask for help when needed	I have learnt to understand different personalities	I have learnt to accommodate my teammates' needs	I have learnt how to make sense from past experience and apply it to the project	I have learnt to take realistic decisions that would solve issues without compromising the success of the project	I have learnt to handle parts of the project that don't have specific requirements (generated ideas, chose solutions...)	I have learnt new computer science topics
	I have learnt to work with others so that they can perform at their best	I have learnt to make people understand what my talents are	I have learnt to focus on my project responsibilities, instead of involving myself in broader issues	I have learnt to make sense of prior knowledge and apply it within the context of the project	I have learnt to seek knowledge and apply it within the context of the project	
	I have learnt to identify when I should step in and give my opinion	I have learnt to collate parts of assignments made by different people to produce a coherent product (documentation, code...)	I have learnt to set goals for the group/sub-group	I have learnt to delegate tasks to others	I have learnt about the types of gales autistic kids would prefer	
		I have learnt to structure teams based on talent	I have learnt how to support people so they can overcome their fears and work at their best	I have learnt to understand others' strengths and weaknesses (talents, knowledge, gaps) to work with them efficiently		
			I have learnt to take responsibilities in resolving conflicts			

## View 2

-3                      -2                      -1                      0                      1                      2                      3

I have learnt new computer science topics; for example, gesture recognition, computer vision, interface design	I have learnt when to reach out for help	I have learnt whom to ask for help when needed	I have learnt to take realistic decisions that would solve issues without compromising the success of the project	I have learnt how to support people so they can overcome their fears and work at their best	I have learnt to accommodate my teammates' needs	I have learnt how to delegate tasks to others
I have learnt how to communicate with demonstrators in a transparent way	I have learnt to focus on my project responsibilities, instead of involving myself in broader issues	I have learnt to structure teams based on talent	I have learnt to understand different personalities	I have learnt how to communicate with clients in a transparent way	I have learnt to identify when I should step in and give my opinion	I have learnt to identify external help resources and support (for instance online)
I have learnt about the types of games autistic kids would prefer	I have learnt to distinguish between feasible ideas and less realistic ones	I have learnt topics related to games: game design, evaluating games	I have learnt to take responsibilities in resolving conflicts	I have learnt to deal with hierarchy within the group (leading or being led)	I have learnt to seek knowledge and apply it within the context of the project	I have learnt to work with others so that they can perform at their best
	I have learnt to handle parts of the project that don't have specific requirements (generated ideas, chose solutions...) I have learnt how to make sense from past experience and apply it to this project	I have learnt to make people understand what my talents are	I have learnt to understand others' strengths and weaknesses (talents, knowledge, gaps) to work with them efficiently	I have learnt to set goals for the group/sub-group	I have learnt to make sense of prior knowledge for practical purposes	
		I have learnt how to communicate with the group in a transparent way	I have learnt how to better understand the end-user (autistic kids)	I have learnt new tools; for example, using Kinect 2.0, unity 3D	I have learnt to collate parts of assignments made by different people to produce a coherent product (documentation, code...)	
		I have learnt to estimate what I can do in a given time	I have learnt to work with people who have different perspectives	I have learnt to take responsibilities for the tasks I have been assigned		
			I have become better at presenting my work; for instance to present ideas to demonstrators, teammates, lecturers			

## View 3

	-3	-2	-1	0	1	2	3
	I have learnt to seek knowledge and apply it within the context of the project	I have learnt to seek knowledge and apply it within the context of the project	I have learnt how to support people so they can overcome their fears and work at their best	I have learnt to understand others' strengths and weaknesses (talents, knowledge, gaps) to work with them efficiently	I have become better at presenting my work; for instance to present ideas to demonstrators, teammates, lecturers	I have learnt to set goals for the group/sub-group	I have learnt to deal with hierarchy within the group (leading or being led)
	I have learnt topics related to games: game design, evaluating games	I have learnt about the types of games autistic kids would prefer	I have learnt to identify when I should step in and give my opinion	I have learnt to take responsibilities for the tasks I have been assigned	I have learnt to work with others so that they can perform at their best	I have learnt to take responsibilities in resolving conflicts	I have learnt how to communicate with the group in a transparent way
	I have learnt to structure teams based on talent	I have learnt how to communicate with demonstrators in a transparent way	I have learnt new computer science topics; for example, gesture recognition, computer vision, interface design	I have learnt how to communicate with clients in a transparent way	I have learnt to make people understand what my talents are	I have learnt to accommodate my teammates' needs	I have learnt to collate parts of assignments made by different people to produce a coherent product (documentation, code...)
	I have learnt when to reach out for help	I have learnt to focus on my project responsibilities, instead of involving myself in broader issues	I have learnt to make sense of prior knowledge for practical purposes	I have learnt to make sense of prior knowledge for practical purposes	I have learnt how to make sense from past experience and apply it to this project	I have learnt to understand different personalities	
	I have learnt to estimate what I can do in a given time	I have learnt whom to ask for help when needed	I have learnt new tools; for example, using Kinect 2.0, unity 3D	I have learnt to take realistic decisions that would solve issues without compromising the success of the project	I have learnt to distinguish between feasible ideas and less realistic ones	I have learnt to work with people who have different perspectives	
		I have learnt to identify external help resources and support (for instance online)		I have learnt to take realistic decisions that would solve issues without compromising the success of the project	I have learnt to handle parts of the project that don't have specific requirements (generated ideas, chose solutions...)		
				I have learnt how to delegate tasks to others			



## CHAPTER TEN

# UTOPIAN PEDAGOGIC SCHOOL OF INNOVATION: ONLINE GAME-BASED LEARNING OF 3D MODELLING

WEE HOE TAN

### **Abstract**

This paper is an instance of how a modelling course was gamified into a series of game-like activities for use in a game-based learning (GBL) website called Utopian Pedagogic School of Innovation. This was an attempt to resolve issues associated to learning 3D modelling software. The GBL practice was based upon mastery learning theory, in which instructional units were structured as missions to engage students, while formative assessment was featured through game challenges to offer reinforcement or enrichment tasks in the form of quests to the students. The students acquired at least 80% of basic knowledge and skills, while developing confidence to take any impromptu modelling task assigned to them. To replicate positive outcomes shown in this GBL practice, quality learning materials should be prepared up front and structured into measurable units, allowing learners to control their pace and monitor their learning progress through formative feedback. Also, they should be allowed to revise and resubmit learning outputs before the submission deadline.

### **Introduction**

This paper attempts to answer how a modelling course could be gamified into a series of game-like activities. Gamification is the process of turning non-game playing activities into game-like activities in a formal and serious context (Deterding, et al., 2011). In this sense, GBL could be a form of learner-centred learning where outputs of gamification might be used *'to actively construct meaning and understanding during every phase of the learning process'* (Yilmaz, 2008). However, GBL can be practiced without going through gamification process if off-the-shelf games have met the expected quality and intended learning outcomes (LOs).

The GBL practice depicted in this paper involved a five-step gamification process, in which a modelling course was turned into a series of game playing activities. The course offered under the Bachelor of Design in Animation programme, at the Faculty of Art, Computing and Creative Industry (FSKIK), Sultan Idris Education University, Malaysia (FSKIK, 2016). The GBL practice involved 27 students who took the course in the third year of the four-year undergraduate study. There were 15 male and 12 female students, aged between 22 to 25 years old. This three credit hours course was run in the second semester of the 2014/2015 academic year, started in February 2015 and ended in June 2015. The course required 120 hours of student learning time across fourteen weeks of study. Every week, a three-hour face-to-face class was arranged in a computer laboratory.

In addition, students continued learning at their own time in order to master modelling knowledge and practical skills.

## Literature Review

In computer graphics, 3D modelling is the process of creating a representation of any three-dimensional surface of an object via a computing process known as rendering (Marichal, et al., 2012). Although 3D models can be created by scanning physical objects (Bellocchio and Ferrari, 2012), novel and original models must be developed from scratch through 3D modelling process in order to visualize imagination of a computer graphic artist or modeler.

The creation of original 3D models commonly requires a modeler who possesses knowledge and skills in using 3D software, such as Blender, 3ds Max, Maya or Cinema 4D. modelling However, many beginning learners failed and gave up due to the steep learning curve and lengthy learning process (Carrington, et al., 2015). modelling

There are websites like Lynda.com and Digital-Tutors group, offering high quality online video tutorials for learning 3D modelling software. However, these materials were too costly for individual students in Malaysian public universities to subscribe because their study required heavy subsidies from the government (Oxford Business Group, 2012, p.211). No doubt, nowadays learners would have access to free online training videos in YouTube, which were created and shared by amateur modelers. However, the accuracy of learning materials is constantly at stake when students tried to learn 3D modelling at their own pace (Sutton, 2015).

In a word, beginning learners of 3D modelling software need a form of mastery learning that contains free, accurate and persistent learning materials. Hence, a modelling course was gamified and delivered over an online GBL website for students to resolve the above mentioned issues. This paper demonstrates how the course went through the gamification process and how the GBL practice supported students to improve the speed, accuracy and persistence of attaining LOs.

## Methods

Prior to the practice of GBL, all students were given a task to create a 3D model using spline tool in 3ds Max. This test was carried out for half an hour to verify whether the students had prior knowledge and skills in modelling and texturing. None of the 27 students showed possession of prior knowledge or skills.

In this course, modelling concepts and skills were organized into instructional units which involved a week or two of instruction (Bloom, 1974). In the GBL practice, these instructional units were coined as missions, challenges or quests. At the end of every unit, formative assessment was administered to gauge information on the progress of attaining LOs (Scriven, 1967). Remedial activities were provided to rectify the performance of individual students who did not learn well (Bloom, Hastings and Madaus, 1971). Students were encouraged to retake missions, challenges or quests in order to improve their scores. In the GBL practice, advanced students were appointed as assistant tutors whose mission was to act as an alternative learning resource to support students who failed to achieve intended LOs.

The game goal was that player's avatar should master the knowledge and skills in Utopian Pedagogic School of Innovation (UPSI) in order to become the Master of Modelling. The goal was further broken down into five objectives, and each of the objectives consisted of three components



which can be aligned to observable behaviours, conditions of attainment and degree of attainment of LOs (see Figure 10.1). The modelling course contains four LOs:

- LO1: Perform basic modelling techniques in the production development process.
- LO2: Determine features and needs of a model using a storyboard.
- LO3: Produce a 3D model using suitable modelling techniques.
- LO4: Work effectively in a team to complete the tasks given.

LO1 can be attained by accomplishing three missions and overcoming a memory and knowledge challenge, LO3 can be acquired via the Speed-combo Challenge and Quest A or B, while LO2 and LO4 can be attained by completing Quest C (see Figure 10.2).

Game goal	Components of game objectives		
	Observable behaviours	Conditions of attainment	Degree of attainment
Avatar should master the knowledge and skills in Utopian Pedagogic School of Innovation in order to become the Master of Modelling.	Memorize...	...major shortcut keys in 3ds Max	...without making any mistake.
	Plan and build...	...a 3D model by using three combination of modeling techniques	...within the given time limit.
	Beat a competing avatar...	...by building a more robust and efficient 3D model	...in a task to be completed in UPSI.
	Cooperate with a competing avatar...	...in a quest to build a creative classroom or a cyborg teacher in Utopian Pedagogic School of Innovation	...and fulfill four principles of pleasure in design.
	Demonstrate personal capability to teach	...3D modeling in Utopian Pedagogic School of Innovation	...using a maximum ten minutes length of instructional screencast videos.

Figure 10.1: Setting three components of game goal and objectives

A web-based physical multiplayer role playing game (PMRPG) was developed on the free Wix HTML5 platform, featuring a quasi-physical world that integrated face-to-face lessons in a computer laboratory and student-centred self-paced learning throughout a semester (see Figure 10.3).

In this game, all players shared the same goal and they would have to earn experience points (XPs) in three missions, two challenges and two quests to achieve the goal. Individual students played the role as an apprentice of a fictional professor named Dr Tan’ology in the game world.

The learning journey began by overcoming basic challenges in three missions during the first three or four weeks. In Mission 1, individual students were given a player avatar identity number, which was hidden somewhere in a pre-created scene of a 3D modelling software. The scene consists of all standard primitive models and spline objects, so when players trying to search for their identity number, they would have to walk through most if not all standard models and spline objects offered by the software. Once they found the identity number, they would be directed to translate, rotate and scale the object into a designated size at the origin of the scene. After restoring the avatar ID, students were instructed to build humanoid or human-like avatar model in Mission 2 using primitive geometry objects. They were also required to create and attain a spline emblem on the avatar model.

In Mission 3, students were guided to create textures of facial features and map the textures on their avatar. As the time spent on all missions was recorded, students were facing time and peer pressure when trying to accomplish every mission. Such pressure directed them to concentrate fully on solving problem in the game world. The outcomes of their attainment in every mission were posted at a web application for communication called Padlet wall (DeWitt, et al, 2015), and leading players were presented in the Hall of Fame.

Course Assessment (Mark)	Features in PMRPG (Score Distribution)	Enabling Learning Outcomes <i>Upon the completion of this mission, you should be able to:</i>
Assignment 1 (20%)	Mission 1: Restore Your ID in UPSI (+5 XPs)	<ul style="list-style-type: none"> <li>• navigate in 3ds Max using Zoom, Pan and Roll tools;</li> <li>• transform object (your id) into designated position, rotation and size in 3ds Max using Select, Move, Rotate and Scale tools.</li> </ul>
To attain LO1	Mission 2: Create Your Primitive Avatar (+10 XPs)	<ul style="list-style-type: none"> <li>• create various types of primitive geometry objects in 3ds Max;</li> <li>• transform primitive geometry objects to form a humanoid character;</li> <li>• create geometry objects using Spline tools, including various types of shapes and Text tool.</li> </ul>
	Mission 3: Activate Your Primitive Avatar (+5 XPs)	<ul style="list-style-type: none"> <li>• prepare texture images in Adobe Photoshop;</li> <li>• create materials for geometry objects in 3ds Max;</li> <li>• texture geometry objects according to preset requirements in 3ds Max</li> </ul>
Quiz & Test (20%)	Memory & Knowledge Challenge (+10 XPs)	<ul style="list-style-type: none"> <li>• Memorize all the essential functions and short-cut keys of 3ds Max (courtesy of Codemasters Studios).</li> </ul>
To attain LO1	Speed-combo Challenge (+10 XPs)	<ul style="list-style-type: none"> <li>• Complete a randomly selected modeling / texturing task in 5 minutes.</li> <li>• Compete with another apprentice and get a judge to determine the winner.</li> </ul>
Assignment 2 (30%)	Quest A: Model Your Dream Classroom (+30 XPs)	<ul style="list-style-type: none"> <li>• Draw your dream classroom in Perspective, Front, Top and Side views.</li> <li>• Edit the four-view drawings in Photoshop for use as modeling reference images.</li> <li>• Build the dream classroom in 3ds Max by referring to the drawings.</li> <li>• Shade and texture the classroom using UVW Mapping technique.</li> <li>• Lit up the classroom using either realistic or stylized lighting setup.</li> <li>• Post work-in-progress 3D turnaround videos (wireframe, shaded, textured &amp; rendered) in Facebook Group weekly to earn XPs and badges.</li> </ul>
To attain LO3	Quest B: Model Your Cyborg Teacher (+30 XPs)	<ul style="list-style-type: none"> <li>• Draw your avatar as a cyborg teacher in Perspective, Front and Side views.</li> <li>• Edit the front and side view drawings in Photoshop for use as modeling reference images.</li> <li>• Model the avatar in 3ds Max by referring to the drawings.</li> <li>• Shade and texture the avatar using UVW Mapping technique.</li> <li>• Set up the classical Hollywood three-point lighting for the avatar.</li> <li>• Post work-in-progress 3D turnaround videos (wireframe, shaded, textured &amp; rendered) in Facebook Group weekly to earn XPs and badges.</li> </ul>
	Assignment 3 (30%)	Quest C: Become a Master of Modeling (+30 XPs)
To attain LO2 & LO4		

Figure 10.2: Mapping game-like activities to four LOs



Figure 10.3: The homepage of Utopian Pedagogic School of Innovation

In the fifth and the sixth week, students were gathered at the Arena UPSI to take up two challenges. The rationale behind conducting these challenges was to verify whether every student has actually acquired fundamental knowledge and skills in modelling or not. The first challenge involved taking an online quiz called Memory Challenge, in which every student must recall all main functions and short-cut keys of the 3D software. After passing the first challenge, students were randomly assigned into pairs, and then compete with each other in the second challenge called Speed-Combo Challenge. In this challenge, one student competed with another student by creating a randomly assigned modelling task in five to fifteen minutes.

Based on the overall performance in three missions and two challenges, students were directed to complete a quest to show off their modelling knowledge and skills. The quest was either modelling a dream classroom, or a cyborg teacher. In this quest, students worked in pairs as the taste

of artistic style and the choice of modelling techniques shown in their 3D models should complement each other’s’ modelling. In the second quest, they were guided to analyze learners’ needs and then design, develop and deploy tutorial videos for 3D modelling. The overall flow of GBL activities is shown in Figure 10.4.

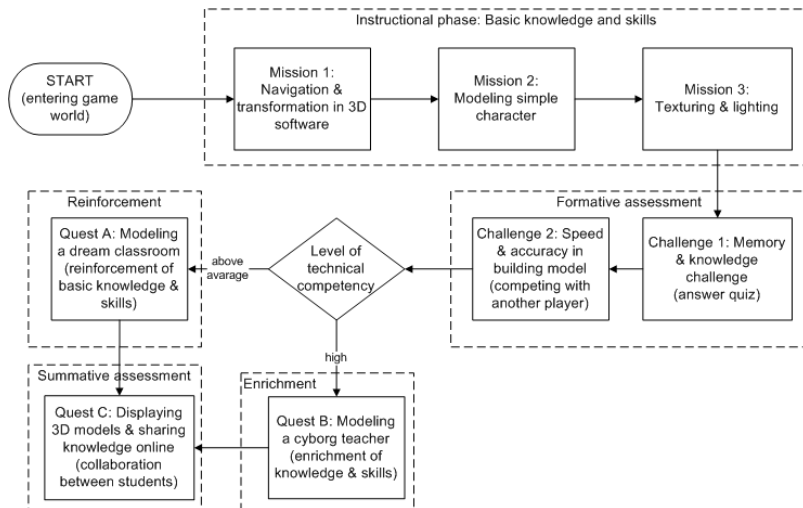


Figure 10.4: GBL activities provided through the PMRPG website

### Results

The assessment of the students’ performance was based 100% on the outputs of coursework. The breakdown of score for every assignment and learning activities was planned two weeks before the semester began. Assessment rubrics of all GBL activities were developed and made accessible to all students in the first week of a semester. Figure 10.5 shows an example of rubric used to assess students’ performance. The rubrics were built according to the National Occupational Skills Standards set for 3D Game Arts production in Malaysia (Malaysia Digital Economy Corporation, 2014).

Grade	Preparation (5)	Modeling (15)	Texturing (10)
A	Drawn <b>creative</b> blueprint in perspective, front, top and side views as required; edited the four-view drawings in Photoshop for use as modeling reference with <b>exact alignment</b> .	Used <b>multiple</b> (three or more) modeling techniques; created the <b>exact</b> model according to the blueprint.	Good preparation of textures; excellent materials; good texturing techniques
B	Drawn blueprint in perspective, front, top and side views as <b>required</b> ; edited the four-view drawings in Photoshop for use as modeling reference.	Used <b>up to two</b> modeling techniques; created the <b>exact</b> model according to the blueprint.	Correct preparation of textures; correct materials; correct texturing techniques
C	Drawn blueprint that is less than requirement; <b>edited some</b> drawings in Photoshop.	Used <b>one</b> modeling technique; created a model that is <b>similar</b> to the blueprint.	Basic use of textures and materials
D	Drawn minimal blueprint for modeling reference; <b>no editing</b> in Photoshop	Used <b>one</b> modeling technique; created a model that is <b>hardly similar</b> to the blueprint.	Partial use of textures and materials
F	No drawings.	Attempted to create a model without referring to blueprint at all	Attempted to use textures and materials

Figure 10.5: The rubric developed for assessing the output of Quest A and B

Through the GBL practice, all students managed to complete all three missions and overcome two challenges by week 6 (see Table 1). In other words, they attained LO1 by scoring at least 80% of XPs and memorized all important short-cut keys, enabling them to start creating 3D models like professionals in the creative industry. All students passed the semester, with the average score of 80.58 (17 scored  $\geq 80$  for A; 8 scored 76-79 for A-; 1 scored 72.4 for B+; 1 scored 68.3 for B). Examples of students' avatar after completing three missions are shown in Figure 10.6. This result indicated that the mastery of basic knowledge and skills in the GBL modelling course had afforded the students to work on any impromptu modelling task assigned to them confidently, therefore resolving the issue of steep learning curve and accuracy of learning materials.

Table 10.1: Students' results in the Modelling course

Teams	Student ID (Gender & Age)	Mission 1-3 (20XPs)	Challenge 1 (10XPs)	Challenge 2 (10XPs)	Quest A or Quest B (30XPs)	Quest C (30XPs)	TOTAL (100XPs)
Panda	M02_24	20	9.7	9	25	25	88.7
	F07_23	18	8.2	8	21	25	80.2
Future Spaceship	M01_23	20	5.5	10	26	24	85.5
	M03_23	18	10	8	24	20	80.0
Halloween School	F02_23	20	8.7	8	26	25	87.7
	M12_23	20	8.7	9	23	25	85.7
Soccer School	F06_24	18	8.4	8	25	19	78.4
	M08_23	18	8.1	7	23	19	75.1
Marine	M09_23	16	1.3	8	23	20	68.3
	F05_23	18	9.4	9	25	20	81.4
Piano Classroom	M10_23	18	8.7	8	25	19	78.7
	F04_23	19	7.4	10	26	19	81.4
Garden Class	M04_25	19	8.4	8	26	24	85.4
	F12_22	20	3.6	9	26	24	82.6
Botanic Environment	F08_23	18	8.1	9	26	26	87.1
	M07_23	18	8.4	8	22	26	82.4
Religious School	M13_23	19	4.2	8	24	21	76.2
	F01_23	18	9	9	23	21	80.0
Bookmarks	M06_23	18	6.2	7	23	22	76.2
	F09_23	18	7.4	8	17	22	72.4
Jupiter Planet	F11_23	19	8.4	9	26	25	87.4
	M14_23	18	9.7	9	24	23	83.7
Roman	M05_23	18	9.4	8	23	17	75.4
	F10_23	18	9	8	24	17	76.0
Boat	M11_23	18	6.6	10	25	21	80.6
	F03_23	18	8.7	9	24	24	83.7
	M15_23	18	8.4	8	19	22	75.4

Based on students' performance in formative assessment, the level of their cognitive capability and technical competency was rated either as above average or high. Those who performed above average were directed to construct a mechanical model in the reinforcement quest, while high achievers were assigned to build an organic model in the enrichment quest. All students completed their quest within the given four week's duration, and they chose to revise the quality of their models at least once. In fact, since the video would be made available online and viewed by the public, the students felt the sense of responsibility to provide good quality tutorial videos for others to rebuild their models.



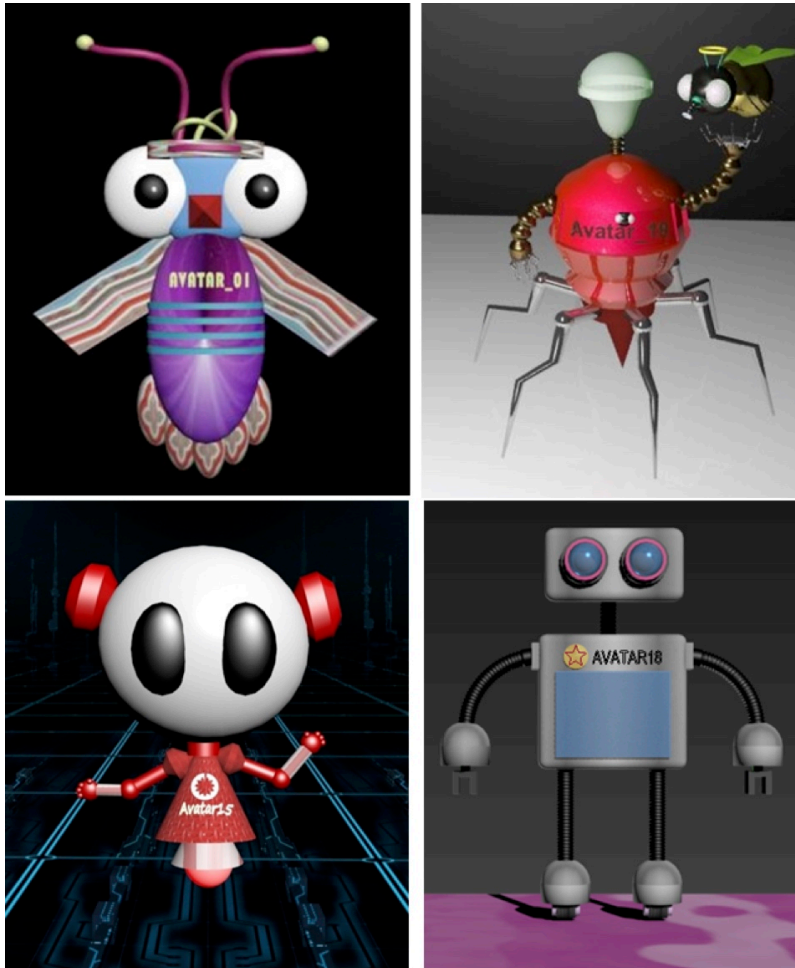


Figure 10.6: Sample avatars created by students at the end of Mission 3

## Discussion

At the end of the semester, the students rated their overall learning experience as 86.15 out of 100 in a learning evaluation conducted by the Academic Development and Quality Division. Compared to other approaches of learning software, the game-based mastery learning practice was seen as an innovative learning experience by the students. They gained not only the knowledge and skills in modelling but also the confidence in taking new challenges. In particular, after completing the course, nine of out 27 students formed a team to offer 3D modelling service to a group of polytechnic lecturers who were interested to produce educational animation for teaching mechanical and marine engineering courses. With the confidence, knowledge and skills developed through the

course, the students completed the project professionally, in which the animation eventually became actual teaching materials in the polytechnic. The success of transferring in-game experience into actual practice at work truly justified the effort and time spent by the lecturer on gamification and game-based mastery learning.

## Conclusion

The purpose of gamification should gear learning towards fun and engaging experience, regardless of what issues a GBL practice intends to resolve. Learners should be given quality learning materials which are structured into measurable units. Learners' performance in these units can be gauged through formative assessment. Then, they should be afforded to control their learning pace, and permitted to revise and resubmit learning outputs within a reasonable time limit.

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## CHAPTER ELEVEN

# USING AN INTERACTIVE VIRTUAL REALITY GAME-BASED EDUCATIONAL APPLICATION TO TEACH MEDICAL STUDENTS ABOUT CYSTIC FIBROSIS

TAMARA VAGG, BARRY PLANT, NICOLA RONAN, JOSEPH  
EUSTACE, AND SABIN TABIRCA

### **Abstract**

Cystic Fibrosis (CF) is a genetic disease which affects multiple organs within the human body. In CF the lungs produce a thick and sticky mucus which can lead to respiratory infections and reduction in airflow. Knowledge of this disease is taught to undergraduate medical students in years 2 and 3, however it is considered that introducing this information through alternate interventions, such as simulation and virtual reality (VR), may prove more beneficial to the learning outcome.

Gamification techniques and the incorporation of games into an educational curriculum have proven advantageous to student's confidence, understanding and enjoyment. Game engines can provide a means for the development of 2D and 3D educational games that can be deployed onto multiple platforms. Such platforms include Windows and Mac executables, web, augmented reality, and VR through a head mounted display (HMD) executable. However, a VR game to disseminate CF education has yet to be created for undergraduate medical students.

This paper presents an immersive VR environment to disseminate CF knowledge to medical students. By focusing on CF for this environment, the system represents a proof of concept model that can be adapted to include other lung pathologies in future adaptations. Simultaneously by allowing the user to navigate freely within this structure to locate educational information, the user is also further enhancing anatomical knowledge of the bronchial tree structure. This can also prove advantageous to those students who will further study bronchoscopies. The proposed environment incorporates gamification elements such as interest points, an objective, player pawn navigation, and gaming inputs such as an arcade pad and Oculus Rift Development Kit 2 (DK2).

This system utilises an instructional design framework that influences extraneous, intrinsic and germane cognitive load to balance the content that **MUST** be learned with the content that **CAN** be learned. As this game was designed for use in a HMD VR setting, content that can be learned was reduced so as not to prolong subjection within this environment and increase the potential for user nausea. This VR educational system has yet to be tested in a clinical setting. However it is anticipated that it will be beneficial not only for disseminating CF educational content, but other areas of lung pathology education once expanded and modified.

## Introduction

Cystic Fibrosis (CF) is a genetic disease that affects many organs within the human body and is the most commonly inherited life limiting genetic condition affecting Caucasians. Ireland has the highest occurrence of this disease in the world. Due to a dysfunction of the Cystic Fibrosis Conductance Transmembrane regulator (CFTR) protein, channels (gates) in the cells experience issues transporting salt and water. In the lungs, this results in a build-up of thick and sticky mucus which is difficult to clear. This causes people with CF to suffer from recurrent chest infections and ultimately lung damage and scarring. This disease is taught from the throughout undergraduate degrees, particularly during the second and third years, and at post graduate level. Utilising innovative and emerging interventions to provide this information, such as gamification and immersive virtual reality (VR), may prove a means to positively contribute to the learning outcome.

Recent proliferation into virtual reality educational applications and software has proven beneficial for teaching complex or abstract concepts (Passig 2016). Furthering this, medical students have confirmed their interest in medical games as an educational intervention. A survey conducted with over 200 medical students in 2010 concluded that 97% of medical students would use the game if it is fun, 77% if it helped to accomplish an important goal and 90% if it helped to develop skills in patient interaction (Kron 2010).

Initial research into games for medical students found that most games are 2D and structured as a quiz. Such games range in topics from patient cases, to pathology and medical terminology; for example the Philips Medical Games collection (Philips 2012). However, 3D educational content found for medical students appears to be primarily focused on simulation and visualisation. A recent project by INVIVO Communications shows that exposure to 3D visual medical content with 360 degree of freedom navigation with the Oculus Rift is engaging among medical professionals and consultants (INVIVO Communications 2015). Considering this, the aim of this work is to combine entertaining aspects found in 2D games with free exploration in an engaging and interactive 3D environment to compliment and improve medical education.

The immersive VR game environment presented in this paper aims to communicate CF knowledge to undergraduate medical students by employing game-thinking and mechanics, which is discussed further in the next section. Focusing on CF for this environment allows the system to represent a proof of concept model that can, in turn include or be adapted for other lung pathologies in future variations. Simultaneously, by allowing the user to navigate freely, as opposed employing restricted or stationary navigation, the user can also further enhance their anatomical knowledge of the bronchial tree structure. This can prove advantageous to those students who will further study bronchoscopies, such as post graduate respiratory specialist trainees.

## Design

The application takes an instructional design approach comprising of two primary categories; *Environment* and *Logic*. *Environment* refers to the game world, and consists of Visual Support, Navigation, and Interface. Discussion of their implementation

*Visual Support* is provided by the inclusion of a 3D bronchial structure which accommodates free navigation, and a series of interest points inside the environment which act as the primary source of visual information. As the user approaches the interest point, a 3D plane appears in its place

containing textual information and multimedia content such as images and videos relating to Cystic Fibrosis. The plane also shows a map of the bronchial structure to aid the user's navigation.

*Navigation* is provided from a first person perspective, and is self-navigation, providing a free-roam environment which the user can explore at their own pace and without a forced path.

*Interface* refers to the user interface within the application. Due to the nature of using a head-mounted virtual reality display and issues related to eye convergence and motion sickness, a standard heads-up display is not used for the user interface. Instead, the planes generated by the interest points act as a projected 3D interface, providing information with minimal interactions.

The second primary category, *Logic*, refers to the game mechanics and purpose within the application, and includes two subcategories:

The previously mentioned *Interest points* are commonly used in first and third person games, and repurposed for the presented VR experience. In this environment, they signify an area within the CF lung which allows for user interaction and an associated task or objective.

*Tasks and Objectives* are presented during the interest point interactions. At certain points the user must perform simple tasks, such as activating a cough animation or using inhaled antibiotics in order to clear mucus from the environment.

Categorising elements in this way is designed to lower the cognitive load demand and allow for greater instructional design and manipulation of the Intrinsic, Extraneous and Germane Cognitive Loads (Sweller 1998). This is done in each category by reducing unnecessary multimedia which may be overwhelming, and ensures that the cognitive processing demand is determined by the user's limits, as the CF content is only displayed on an overlap with each interest point. This design also balances the content which **MUST** be learned with the content which **CAN** be learned (Becker 2012). As this game was designed for use in a HMD VR setting, multimedia content and content that can be learned was reduced so as not to prolong subjection within this environment and increase the potential for user nausea. Additionally, as this system is tailored towards final year medical students, there is the potential that external learning achieved through previous year's studies may influence the user's success within the game. Lastly, it is essential to weigh game mechanic complexity with the learning value. By lowering the game mechanic complexity, the potential for over-stimulus in the VR environment is also lowered. In this way, the focus is more on the quality of the content being provided within the environment, both textual and multimedia. All content used within the system was written and validated by a CF consultant.

## **Methodologies**

A 3D model of the bronchial tree structure is created in the modelling software Blender version 2.73 and based on schema diagrams of the structure given to medical students. The orifice to the right middle lobe and lingula in the left upper lobe are applied with an animation resembling pulsation. The left superior bronchus is applied with a cough like animation. All completed animated models are then exported as FBX models and imported to the Unreal Engine version 4.7.9 (UE4) with morphs. This game engine was chosen as not only does it provide an extensive building environment, it also uses techniques and approaches synonymous with the creation of games. This satisfies the need to include gamification in the educational environment, which has proven beneficial in many areas of medical pedagogy (Clark 2013). Five interest points corresponding to educational content and instructions on interactive elements are then apportioned in the imported bronchial model.

The aforementioned interest points are 3D letter “i”s that are coupled with a bounding box, as seen in Figure 11.1 A. During “on overlap” events (when the player pawn overlaps with the bounding box), this 3D i is hidden and a widget is then dynamically spawned corresponding to the respective interest point. This widget contains both the educational content and also elements more commonly found in a user interface, such as a mini map and additional multimedia such as imagery and videos. The choice to integrate both these UI elements and educational content into a singular widget that is not attached to the user's viewport is made to reduce issues related to eye convergence when wearing the head mounted display. This widget can be seen in Figure 11.2 A and 11.2B.

In addition to widgets, overlapping certain interest points will provide access to interactive animations while the user is within a short radius. An example of this can be seen in figure 1 B, where the user can press an assigned button on the controller to generate a stream of antibiotics that pass through the lung and reduce the mucus build-up in that area of the pipe. This antibiotic animation and an additional cough animation allow the user to change or alter the lung environment through interaction. The behaviour and control logic for the immersive environment is scripted in UE4’s node-based visual scripting environment, Blueprints.

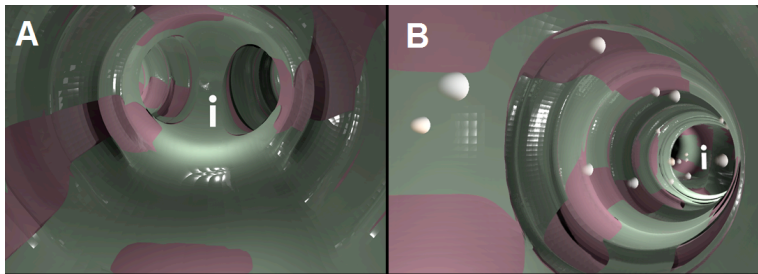


Figure 11.1: Interest point marker (A) and interactive antibiotics animation (B)

The navigation incorporated into this immersive environment is the UE4 default flying player pawn, however some minor changes were made to accommodate for an arcade stick input. The user can control pitch, roll and yaw by moving their head while wearing the head mounted display. Forward, back, left and right movements are inputted via the joystick on the arcade pad. An issue encountered with this setup is that both arcade stick and head mounted display are tethered, making it difficult for the user to rotate 180 degrees to turn around. To solve this, the left trigger (LT) and right trigger (RT) buttons are also assigned left and right yaw movements respectively. By pressing these buttons, the user’s yaw is slowly altered, allowing the user to turn around with minimal risk of causing nausea. The remaining buttons on the arcade stick are then assigned to user interactivity events, including teleporting, coughing and generation of inhaled antibiotics.

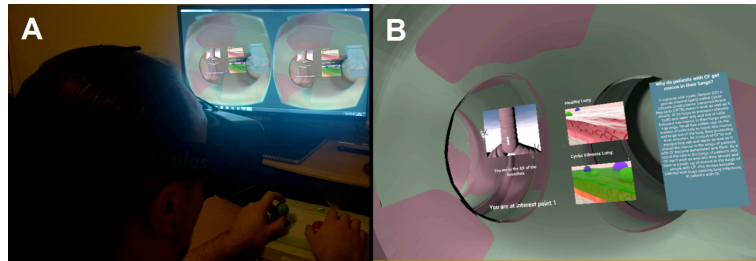


Figure 11.2: Stereoscopic view of environment (A) and non-stereoscopic view of interest point (B)

The player pawn start point is removed from the bronchial structure and instead placed in a separate, self-contained room with a single interest point. Once the simulation has begun, the user is given the opportunity to move around in this environment and become accustomed to the controls. Once the user overlaps with the interest point a widget is displayed providing further information on controls and objectives. The user can then press the appropriate button on the arcade stick to teleport to the main game area and explore the bronchial structure. The complete system is exported for stereoscopic view on the Oculus Rift Development Kit 2.

## Evaluation

The VR game environment was subjected to usability testing in order to validate its feasibility with higher level students. A pluralistic walkthrough was conducted with a group of 5 students to record qualitative data that evaluates the end-user's perceived usefulness of the environment (Lee 1999), during which the users were introduced to the controls and primed for use of the VR HMD (LaBorde 2013). The decision was made to enrol only 5 students for this study as this is preliminary stress testing while approval is sought to begin formal testing. The users were given three tasks to perform during the pluralistic walkthrough. The first task was to locate all the interest points within the lung. Once this was accomplished the user was asked to read all the information available on the interface. Lastly the user was requested to complete the environment interactions displayed at each interest point. While using the HMD and exploring the environment, data was collected about the users' interactions and behaviours through observation, and each was asked to think aloud about their experience during the observation.

It was observed that the users spent the most time at task one (approx < 3 min). From the comments made by the users and author observations, the main cause for this was due to the user continuing to adjust to the use of head movement to navigate. However, this was no longer an issue by task three, as the user had quickly adapted to the new control mechanism. During task two four of the five users experienced difficulty reading the textual information but experienced no issue when viewing an animation or image. This was found to be due to the angle in which the users were looking at the text as in some cases it may appear blurry. The users were then prompted to adjust their position to view the text, which took between two and four attempts. After this, the user was able to read the text without complaints. It was suggested by the users to incorporate a button that would position the user to an "optimal reading location". It was also commented that a prompt should appear reminding the user that they could lean in and out to view more or less of the text. For the final task, all users were able to locate all the interactions and activate them with ease by using the gamepad. Interactions within the environment would only affect certain areas of the lung

and the game experience would need to be restarted to view again. Three of the five participants commented that they would prefer if the cough and inhaled antibiotic interactions could affect the entirety of the lung and that the mucus could grow back over time. After the third task was complete the users were provided time to explore the and interact with the game experience without prompting from the authors, however the users must continue to speak aloud any feedback they may have.

Generally, the feedback received from the students was positive. It was regarded as fun and interesting, which promoted exploration, and motivated users to continue engaging with the experience until they had interacted with most or all of the available content. This feedback is similar to the findings of INVIVO Communications 3D VR medical content discussed in the introduction section. Three users commented on the tools usefulness as part of their studies, advising that the tool could benefit their practical knowledge of anatomy and visual understand of CF. A time limit was not imposed on the user, however every effort was made to minimise the possibility of nausea as any amount of discomfort such as this can be distracting, and detrimental to the learning experience.

An issue encountered during testing that can cause a break in this immersive environment is that the user can navigate to the edge of the model, and although collision detects the player pawn and prevents from breaking out, the user can look through the model by leaning forward while wearing the DK2. Once the user looks through the wall, they can view the external VR environment which contains no other objects. A solution suggested for this is to contain the bronchial model within a larger lung model textured with a lung lobe material, which would result in the user seeing the lung as opposed to the nothingness in the VR environment should they break through. Additionally, if the user is not primed or prepared for this immersive environment, they can experience nausea and motion sickness. Likewise, this system can have a negative effect on users who are sensitive to claustrophobia.

## **Conclusion and Future Works**

Future work for this project involves incorporating further levels and challenges for the user. Currently it serves as a proof of concept model that can be utilised for other areas of the body. As mentioned previously, CF affects many organs of the body and future levels of this game could include exploring those organs, such as the gut and pancreas. Additionally, specific information pertaining to a random patient may be incorporated into the exploration of these interest points. For example, at an interest point describing the various bugs in the lung a specific bug can be assigned to a virtual patient and before completing the environment the user must answer a question, such as if the patient's current treatment is sufficient for the bugs they are harvesting. On completing this question correctly, the user can then progress to the next level.

Recommendations for future similar works is to investigate porting these VR educational games for Android so that it can be used with wireless HMD's such as the Gear VR and Google Cardboard. New VR inputs such as the Oculus touch controllers should also be investigated. Additionally, such systems must be designed for seamless incorporation into a lab, lecture hall or simulation centre that can be accessed easily by the intended medical students. It is also recommended that a design approach such as instructional design is incorporated into the game environment. Similarly, it is also recommended that a player tracker can be developed and incorporated into the game system, such a tracker will aid in the understanding of successful and unsuccessful interactive elements, which can then be improved.

In conclusion, the presented environment was found to be novel and fun amongst students and can benefit learning engagement. However, the system requires that each user is primed for the immersive environment so as to prevent or reduce feelings of nausea. Additionally, the recorded

feedback from the pluralistic walkthrough requires implementation before embarking on clinical testing. It is anticipated that this environment will prove beneficial to higher level medical education and can be altered to incorporate other pathologies and educational content for future adaptations.

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## CHAPTER TWELVE

### WHEN COMPETITIVENESS OVERSHADOWS LEARNING. A CASE STUDY OF A DIGITAL GAME-BASED LEARNING AND ASSESSMENT INITIATIVE IN A THIRD LEVEL SETTING.

MAIREAD BRADY, ANN DEVITT, PATRICK GEOGHEGAN,  
CONOR O'FLANGAN, RYAN KANE, DAVID CLINCE, MICHAEL  
BURNS AND CAMILLE JULIEN-LEVANTIDIS

#### **Abstract**

As digital games and simulation enter higher education as a mode of learning and assessment it is incumbent on researchers to explore the impacts for students with a particular focus on how this form of assessment supports or detracts from learning. This paper sets out a case study of third level student groups engaging with experiential learning in a simulation serious game for higher-order cognitive development, focusing in particular on the winning group. The research objective was to explore the effects that winning the digital game had on the learning of and engagement with the course content. The findings suggest that game mechanics and the desire to win can overshadow the actual learning, particularly in the absence of clear feedback to students. Though winners of the game, the winning group felt that they had succeeded in beating the game mechanics rather than in integrating the learning aligned to the module. This paper asks does gaming within higher education benefit learning and is this uniform across the different rankings from winners to losers?

#### **Introduction**

For many students games are a norm of their environment and many students are gamers in their spare time. At any moment up to 1.2 billion people around the globe are playing either single or multi-player digital games either online, on apps or through TV sets. In the US alone over 150 million people play games regularly, and 42% of Americans *play* for at least three hours per week. In much of the western world gaming is pervasive across all age groups and socio-economic profiles (ESA, 2015). It has been suggested that technology in education and particularly digital game-based learning can take students out of their academic comfort zone and into the messy but real world of indecision, complexity and failure, Barnett's 'anxiety-provoking places' (2007, p. 147). Shulman (2005) suggests that there should be a certain amount of anxiety and risk that if there is no emotional investment, no intellectual or formational yield, then there will be no real learning. It could be said

that the current ‘final’ exam or essay as assessment has students and academics in cahoots to ensure that the students ‘do’ university, with an assessment culture that is familiar, easy and understandable (Land, 2015).

In this study, an assessment design was created aligned to Assessment for Learning framework (Samball et al., 2013). This design included a game-based learning element intended to create an assessment and learning environment which was more reflective of the world of work, with indecision, complexity and failure inbuilt into the system. This research aims to explore whether students are willing or able to learn through games, (Steinkuehler, Squire, and Barab, 2012) and also whether they can achieve higher order learning outcomes, such as application and synthesis of knowledge (Bloom et al, 1956), within this simulation game. The specific focus of this paper is to explore the effect of competition, winning and losing, on learning within the game environment.

### **The Effects of Competition**

A core aspect of the SG environment was the visibly competitive nature of the game with team performances updating on a scoreboard after each round. Though there is work on competition in gaming, there is no clear agreement on its impact. Nebel *et al.* (2016) carried out a study on how competition enhances or diminishes various aspects of educational videogames such as cognitive load, focused attention, satisfaction, perceived usability and situational interest, and found that competition placed irrelevant or unnecessary loads on players, rather than assisting them in the learning of relevant materials. They found that detail and fact-transfer knowledge acquisition were reduced by competition, and competition was unrelated to information retention. Other studies have produced similar results. For example, Ke (2008) found that it was only when students played the game on their own that the cognitive learning effects of the videogame were enhanced. In an experimental study of student learning in a game environment, Vandercruysse et al. (2013) did not find a statistically significant relationship between competition and students learning. However, other studies have shown that competition increased in-game learning, compared to individual play (Plass et al., 2013), and competition significantly increases post-test scores (Cagiltay et al., 2016, Chen & Chen, 2014). Using the Self-Determination Theory framework of autonomy, competence and relatedness as components of motivation (Deci and Ryan, 2012), Yee (2006) identified competition as a factor in motivation for game players. Many studies show that competition in educational video games enhances motivation to some degree (Vandercruysse et al., 2013, Ke, 2008, Chen & Chen, 2014, Nebel et al., 2016). Focusing on relatedness, Chen (2014) found that students tend to isolate the social competitive dimension from the learning dimension, suggesting that students concentrate on only one dimension at a time. Students were also seen to spend approximately 70% of their time playing, competing, or taking part in activities related to the social dimension but students rarely transitioned from the social dimensions to the learning dimension. These findings strongly suggest that in some games learning and gaming goals are not tightly aligned resulting in the potential to decouple the two behaviours.

## Methodology

This research was carried out as a case study within a large cohort Marketing Management module in an Irish university. The study participants were 40 students who elected to play a marketing simulation game as part of a group assignment. The 40 students were divided into 8 groups of five. The simulation game required each student team to build a marketing strategy over the course of 8 quarters for a jeans company. Within the game, teams are awarded points based on “Tactical Decisions” such as target market selection, advertising methods, and pricing strategies (competitive dimension). Students are also asked to explain their “Strategic Decisions” in relation to core marketing concepts (learning dimension). These explanations of strategy do not contribute to the team score. The game did not allow what Dwerk (2010) calls ‘trying over’ which can allow students to develop mastery through repetition. Instead, this game’s mechanics carried the effects of all players’ marketing decisions throughout the game, making failure possible if certain core concepts were mis-applied at any stage in the game.

The data collected included an unstructured reflective statement (approximately 1000 words) completed by each participant one week after the completion of the marketing plan assignment and three weeks after completing the game. This graded work asked students to discuss whether the game had supported their learning. A thematic analysis of the reflective statements was carried out using MaxQDA. This paper focuses specifically on the group that won the simulation game, a group of 4 male computer science and business students with one female Erasmus student member. An in-depth consultation session was carried out with the team members to validate the findings of the thematic analysis.

### **Case Study method and findings: Does competitiveness overshadow learning?**

There is some debate as to whether winning teams learn as much as losing teams, with contradictory findings (see Brady, Devitt, Lamest and Gomez, 2015). The focus of this analysis was on how winning the game affected learning. The findings of the thematic analysis of reflective statements of the winning team in contrast with other teams would suggest that there were interesting behavioural differences between the winning team and other teams. This was also noted in the consultation with the winning group themselves. In the first few quarters, the winning team was performing poorly. They changed their decisions a number of times, but to no avail. Then one quarter, they jumped from last place into second place. Once this happened, the group’s attitude toward the game changed drastically. The learning aspect of the game was almost forgotten and all their concentration was on the competition. The group climbed to first place and remained in that position until the second last quarter of the game, when they dropped back down to second place. This only amplified their competitive state. The marketing plan, which was the main assessment output, was almost completely disregarded as the group focused on regaining the top position. They scored points for their tactical decisions but did not complete the strategic decision components to link their tactics with marketing concepts. Only when the game was finished did they realise the amount of learning that they had missed out on. As a result, the winning students were less satisfied by playing the game than those who positioned lower.

The analysis of the reflective essays of the winning team shows a strong emphasis on winning points to increase their visible ranking. The learning dimension of the game was isolated and disregarded as winning became the priority. This ranking was not aligned with how they were progressing on the learning or the written assignment. Students in the winning team found that the lack of feedback from the game other than the scoreboard diminished their learning. They were

confused as to how points were awarded and why there were winning. This lack of feedback caused the students to “game the game” (Robson et al., 2015), particularly in the final rounds. Conversely, students from other groups and particularly lower ranked groups understood that they had misunderstood some of the theory, mis-applied concepts which clearly affected their ranking. They were then motivated to turn their attention to the learning aspect (strategic decisions) to find out why they had failed.

Within the concept of games there is the view of winners as winning and losers as losing. There are also groups or individuals who consider that the main goal must be to win, while others enjoy the challenge of playing the game (Bartle, 1996). But has winning in games become the reward in and of itself? Our own study found that the winning team self-reported learning less than the losing team. Students from the losing team noted that they learned valuable lessons from making mistakes in the games, whereas students in the winning team were unsure of how or why they were winning as they had focused on the game dynamics and the game’s rules and mechanics worked to win the game. For students in the winning team, all the learning took place post-game as they rushed to complete the assignment aligned with the game. This supports evidence from previous studies that the winning group do not take the most learning from the game (Brady et al., 2015). It also generates questions as to the value of competition for learning where competition can take over as an end in itself.

### **Discussion**

The game design which isolated the competitive and learning dimensions of the game had a detrimental effect on the winning students. Both dimensions required equal effort, but far less time was given to the learning dimension, as in (Chen, 2014). Competition did increase the motivation of students for the winning team but it only motivated them to compete and not to learn. Whereas for the losing team the opposite was true, when a team lost their motivation to compete, they became motivated to learn. This study confirms the complexity of the motivation construct and strongly indicates that research must decouple learning motivation from motivation to participate as in Vandercruysse et al. (2013) in order to assess accurately the effects of competition on learning.

In learning games, there must be effective ways of balancing out the competitiveness and the learning. In line with Van Eck (2006) and Prensky (2012), we emphasise that success in serious games should be measured relative to learning criteria, effective and efficient application of theory to practice for example. We acknowledge however that in terms of technology this may be more difficult to measure within a game. Students will most likely continue to game the game manipulating the game mechanics to achieve victory if the game mechanics allow. Working around obstacles within games can be inventive and challenging for students but the gaming of the game is a real challenge especially when learning not winning is the core requirement. In this case the best gamers won rather than the team that learnt the most.

### **Conclusion**

Trenholm et al. (2012:709) suggests that with game-based learning there is the danger of being lead by a ‘*mirage of benefits*’. That digitalising education can be more focused on a sense of efficiency, scalability and apparent student gains rather than solid empirical studies. This working paper explores core aspects of game-based learning including the specific affordances of the technology which can enhance or detract from learning. This study focussed on the effect of winning

on student higher order learning using a simulation game designed for learning, within a third level environment. The preliminary findings suggest that the winning group became over-focused on winning and manipulating the game mechanics. This would suggest that where game and learning goals are not integrated, students' motivation to succeed may not translate into learning gains. This raises real questions about a possible mismatch between the educational aims of academics to incorporate serious games and the gaming behaviour of their students.

This paper studied the impact of winning on learning and suggests that due to the design of this game and other aspects of the motivation of the group and the application of the game winning actually detracted from the learning. We suggest that there is a real need for further research on the impact of winning or losing and its effect on learning.

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## CHAPTER THIRTEEN

### AN ANALYSIS OF LEARNERS' MOTIVATIONS AND ATTITUDES FOR PLAYING COMPUTERS FOR LEARNING IN THE CHINESE HOTEL INDUSTRY

KUN FU, THOMAS HAINEY, GAVIN BAXTER AND YUAN  
YUAN

#### **Introduction**

The structure of core-cooperativeness in hotel organizations determines not only their infrastructures, but also their service quality. To maintain and improve service quality, training plays a vital role. However, the actual training program cannot satisfy the growth of the hotel sector required (Zhang et al., 2002). Various factors constrain the implementation of the hotel training programs, such as financial constraints (Wood, 1994), high labour turnover (Boella, 2000), and lack of training customs (Mullins, 1998). Traditional approaches, including paper-based, tutorials, lectures, demonstrations and role-play are utilized to train Chinese hotel employees in knowledge acquirement, technical skills and emotional attitude (Ahammad, 2013).

Serious games have demonstrated their use in the business sector, and have the potential advantages to overcome the limitations of traditional training approaches (Ranchhod, Gurău, Loukis and Trivedid, 2014; Katsaliaki, Mustafee and Kumar, 2014). De Freitas (2006, p9) defines games-based learning (GBL) as “*applications that can use the characteristics of video and computer games to create engaging and immersive learning experiences for delivering specified learning goals, outcomes and experience*”. Games-based learning engages learners to participate in learning through gameplay. The application of GBL approaches could effectively satisfy training requirements (Faria, Hutchinson, Wellington and Gold, 2009), and improve the degree of training efficacy (Dye, Green and Bavelier, 2009). Many GBL designs in the literature are related to the learning outcomes of the GBL and their effectiveness in business training (Wiebenga, 2005; O’Neil, Wainess and Baker, 2005). The role of motivation, and its integration into the game design model, has been considered. Although, it is important to also gain empirical evidence about attitudes towards games-based learning to gauge acceptances prior to developing game applications for the Chinese hotel employees. This paper aims to identify learners’ attitudes and motivations for using games-based learning to train staff in the Chinese hotel sector.



## Participants

Data was collected from a total of 524 valid respondents by online surveys over a three-week period in November 2015. Participants were invited by the researchers to fill-out the online survey. Most of participants were from the south of China. There were a total of 524 valid respondents, of which 239 (45.6%) were male and 285 (54.4%) were female. 216 (41.2%). Participants reported their education as being at university level, followed by high school and below (187; 35.7%), college (107; 20.4%), and graduate school (14; 2.7%). Participants ranged from 18 to over 45 years old; the largest number of respondents were aged between 18 and 25 years old (55%), which is nearly twice as large as the age group of participants aged between 26 and 35 years old (30.9%). 11.1% of the respondents were aged between 36 and 45 years old, and only 3.1% of them were aged over 45 years old. Of the 524 participants who answered the questions related to their occupation, 138 (26.3%) participants were a waiter or a waitress (this was the largest number of respondents), 99 (18.9%) were front desk clerks, 64 (12.2%) were kitchen staff, 54 (10.3%) were porters, 53 (10.1%) were managers, 43 (8.2%) were working in housekeeping, 42 (8.0%) were working in administration and 31 (5.9%) worked in marketing.

The questionnaire contains demographic variables, game playing habits, motivation for playing games and for using computer games for training, attitudes and acceptance to playing computer games, and skills gained. Demographic variables included age, gender, education and occupation. Game playing habits included questions on the types of games they played most frequently. Yee's (2006) motivations for playing online game, Wu, Wang and Tsai's (2010) gratifications perspectives and Malone and Lepper's (1987) framework of intrinsic motivation were used to examine the reasons for playing games. Liu, Lee and Chen's (2013) computer game attitude scale and Saleh, Prakash and Manton's (2014) students' acceptance of GBL scales were used to examine the general attitudes toward playing computer games. Participants were asked to specify the types of skills can be obtained from computer games that would be relevant to businesses. This was a multi-choice question that included the following categories: problem solving, reflection, analyzing and classifying, collaboration and teamwork, leading and motivating, and critical thinking, and emotion and attitudes.

## Results

94.6% (226) of male participants and 94.7% (270) of female participants played computer games, and 28 participants did not play computer games. 34.4% (180) of the participants had played computer games for 1 to 3 years, followed by 24.8% (130) of participants who had played games for 4 to 8 years and 23.1% (121) of them had played for less than a year. A Man-Whitney U test indicated that gender significantly influenced the reasons for playing computer games.

31.7% (157) of participants stated that they played games for less than one hour per week and 20.4% (101) of them played for 6 to 15 hours per week. A Mann Whitney U test indicated that there were significant differences in the time spent playing computer games in relation to gender ( $Z = -5.27$ ;  $p = .000$ ). The results showed males played computer games (8.36 hours;  $SD = 8.03$ ) significantly longer per week than females (5.22 hours;  $SD = 6.60$ ).

53.2% (264) of participants preferred to play single-player games. Participants played multi-player games (5.21 years; SD=4.16) for more years than single-player games (3.37 years; SD=3.45). A Mann Whitney U test showed that there were significant differences in participation in gameplay per week in relation to game types. 496 of participants indicated the types of games they played. This was a multiple choice question. The classification of game genres was based on Grace (2005) and MobyGame (2016) systems. Table 1 shows the percentage of males and females who played each type of game. Strategy (34.1%) and Puzzle (32.9%) game were rated as the most popular games to play in general. Male preferred MMORPGs, however, females were interested in puzzle, strategy and board games.

Table 13.1: The percentage of males and females who played each type of games

	Rank	N	%	Male			Female		
				Rank	N	%	Rank	N	%
Strategy	1 <sup>st</sup>	169	34.1%	4 <sup>th</sup>	76	33.6%	2 <sup>nd</sup>	93	34.4%
Puzzle	2 <sup>nd</sup>	163	32.9%	12 <sup>th</sup>	36	15.9%	1 <sup>st</sup>	127	47.0%
MMORPGs	3 <sup>rd</sup>	150	30.2%	1 <sup>st</sup>	101	44.7%	8 <sup>th</sup>	49	18.1%
Action	4 <sup>th</sup>	134	27.0%	3 <sup>rd</sup>	84	37.2%	7 <sup>th</sup>	50	18.5%
Board game	5 <sup>th</sup>	127	25.6%	10 <sup>th</sup>	42	18.6%	3 <sup>rd</sup>	85	31.5%
Adventure	6 <sup>th</sup>	126	25.4%	7 <sup>th</sup>	60	26.5%	5 <sup>th</sup>	66	24.4%
Role playing	7 <sup>th</sup>	123	24.8%	5 <sup>th</sup>	69	30.5%	6 <sup>th</sup>	54	20.0%
First Person shooter	8 <sup>th</sup>	121	24.4%	2 <sup>nd</sup>	85	37.6%	12 <sup>th</sup>	36	13.3%
Fighting	9 <sup>th</sup>	107	21.6%	6 <sup>th</sup>	68	30.1%	11 <sup>th</sup>	39	14.4%
Racing game	10 <sup>th</sup>	100	20.2%	8 <sup>th</sup>	55	24.3%	9 <sup>th</sup>	45	16.7%
Rhythm	11 <sup>th</sup>	97	19.6%	13 <sup>th</sup>	19	8.4%	4 <sup>th</sup>	78	28.9%
Simulation	12 <sup>th</sup>	82	16.5%	11 <sup>th</sup>	37	16.4%	9 <sup>th</sup>	45	16.7%
Sports	13 <sup>th</sup>	73	14.7%	9 <sup>th</sup>	50	22.1%	13 <sup>th</sup>	23	8.5%
Others	14 <sup>th</sup>	22	4.4%	14 <sup>th</sup>	10	4.4%	14 <sup>th</sup>	12	4.4%

496 respondents answered the questions related to the reasons for playing computer games question, to the reasons for using computer games for business training, and about the attitude and acceptance to playing computer games. The five-point Likert scale was used. Table 2 shows the mean rating for each reason for playing computer games. Enjoyment (Mean=3.83; SD=0.77), competition (Mean=3.75; SD=0.76) and relationship (Mean=3.74; SD=0.78) were rated the three most important reasons for playing computer games. The results showed that the mean rating by males of reasons for playing computer games was much higher than for females. This suggests that males may be more interested in playing computer games than females. A Mann Whitney U test indicated that there were significant differences in reasons for playing computer games in relation to gender and game types. Cooperation, challenge and control were regarded as the important feature

for using games-based learning. Perceived usefulness and leisure and ease of use positively impacted on attitudes toward playing games. The majority of respondents agreed that computer games were useful in gaining skills and knowledge.

Table 13.2: Reasons for playing computer games

Reasons	Rank	Mean	SD	Male			Female		
				Rank	Mean	SD	Rank	Mean	SD
Enjoyment	1 <sup>st</sup>	3.83	0.77	1 <sup>st</sup>	3.99	0.75	1 <sup>st</sup>	3.70	0.76
Competition	2 <sup>nd</sup>	3.75	0.76	2 <sup>nd</sup>	3.94	0.75	2 <sup>nd</sup>	3.59	0.72
Relationship	3 <sup>rd</sup>	3.74	0.78	3 <sup>rd</sup>	3.92	0.79	3 <sup>rd</sup>	3.59	0.74
Discovery	4 <sup>th</sup>	3.69	0.79	4 <sup>th</sup>	3.91	0.77	4 <sup>th</sup>	3.51	0.77
Teamwork	5 <sup>th</sup>	3.68	0.87	5 <sup>th</sup>	3.89	0.84	5 <sup>th</sup>	3.50	0.86
Customization	6 <sup>th</sup>	3.67	0.84	6 <sup>th</sup>	3.87	0.79	6 <sup>th</sup>	3.50	0.85
Socializing	7 <sup>th</sup>	3.63	0.87	7 <sup>th</sup>	3.85	0.89	9 <sup>th</sup>	3.45	0.82
Role-playing	8 <sup>th</sup>	3.63	0.81	8 <sup>th</sup>	3.84	0.76	8 <sup>th</sup>	3.46	0.81
Mechanics	9 <sup>th</sup>	3.61	0.78	9 <sup>th</sup>	3.77	0.78	7 <sup>th</sup>	3.47	0.74
Advancement	10 <sup>th</sup>	3.57	0.82	10 <sup>th</sup>	3.76	0.77	10 <sup>th</sup>	3.42	0.83
Recognition	11 <sup>th</sup>	3.51	0.97	11 <sup>th</sup>	3.73	0.97	12 <sup>th</sup>	3.33	0.93
Escapism	12 <sup>th</sup>	3.48	0.87	12 <sup>th</sup>	3.59	0.91	11 <sup>th</sup>	3.38	0.83

Table 3 shows the mean ratings of the reasons for using computer games for business training. Relaxation (Mean=3.93; SD=0.80), leisure (Mean=3.90; SD=0.83) and pleasure (Mean=3.90; SD=0.84) were rated the top three reasons for using GBL in business, and were all rated as important. In the context of Malone and Lepper's intrinsic motivation (1987), cooperation (Mean=3.89; SD=0.84) was regarded as the most important reasons for using GBL, challenge (Mean=3.88; SD=0.82) were rated as slightly less important. Curiosity (Mean=3.7; SD=0.95) and fantasy (Mean=3.57; SD=1.01) were the least important reasons for using GBL for business training. A Mann Whitney test indicated that there were significant differences in the reasons for using GBL in relation to gender ( $P < .01$ ). In addition, there were significant differences in the reasons for using GBL in the dimensions of relaxation, leisure, cooperation, challenge, control, competition and recognition in relation to game types ( $P < .05$ ). According to the results of the Kruskal-Wallis test, there were significantly differences between the reasons for using GBL in relation to education but expect relaxation dimension ( $P < .05$ ), and occupation group variables significantly affected fantasy and pleasure dimensions for using GBL ( $p < .05$ ).

Table 13.3: Reasons for using computer games for business training

Reasons	Rank	Mean	SD	Male			Female		
				Rank	Mean	SD	Rank	Mean	SD
Relaxation	1 <sup>st</sup>	3.93	0.80	1 <sup>st</sup>	4.02	0.86	1 <sup>st</sup>	3.85	0.74
Leisure	2 <sup>nd</sup>	3.90	0.83	4 <sup>th</sup>	3.99	0.90	2 <sup>nd</sup>	3.82	0.76
Pleasure	3 <sup>rd</sup>	3.90	0.84	2 <sup>nd</sup>	4.00	0.87	3 <sup>rd</sup>	3.82	0.80
Cooperation	4 <sup>th</sup>	3.89	0.84	3 <sup>rd</sup>	4.00	0.88	5 <sup>th</sup>	3.80	0.80
Challenge	5 <sup>th</sup>	3.88	0.82	7 <sup>th</sup>	3.95	0.91	4 <sup>th</sup>	3.81	0.74
Control	6 <sup>th</sup>	3.84	0.87	6 <sup>th</sup>	3.95	0.89	7 <sup>th</sup>	3.75	0.84
Competition	7 <sup>th</sup>	3.83	0.86	5 <sup>th</sup>	3.97	0.90	6 <sup>th</sup>	3.80	0.80
Recognition	8 <sup>th</sup>	3.72	0.93	8 <sup>th</sup>	3.88	0.92	9 <sup>th</sup>	3.59	0.84
Curiosity	9 <sup>th</sup>	3.7	0.95	9 <sup>th</sup>	3.81	1.00	8 <sup>th</sup>	3.60	0.89
Fantasy	10 <sup>th</sup>	3.57	1.02	10 <sup>th</sup>	3.70	1.08	10 <sup>th</sup>	3.46	0.95

Table 4 displays the mean rating of general attitudes to playing computer game with 524 participants. Perceived usefulness (Mean=3.79; SD=0.83) was rated as the most important factor, followed by leisure (Mean=3.69; SD=0.75), and perceived ease of use (Mean=3.69; SD=0.82). Confidence (Mean=2.69; SD=0.93) was rated as the lowest important factor to influence attitudes and acceptance to playing computer games. A Mann-Whitney test indicated that there were significant differences in general attitudes to playing computer games in relation to gender, except confidence variable ( $p < .01$ ), moreover, game types variables significantly affected the dimensions of linking, participation and leisure toward playing computer games ( $p < .01$ ).

Table 13.4: General attitudes and acceptance to playing computer games

Reasons	Rank	Mean	SD	Male			Female		
				Rank	Mean	SD	Rank	Mean	SD
Perceived usefulness of	1 <sup>st</sup>	3.79	0.83	1 <sup>st</sup>	3.90	0.83	1 <sup>st</sup>	3.70	0.82
Leisure	2 <sup>nd</sup>	3.69	0.75	2 <sup>nd</sup>	3.83	0.74	3 <sup>rd</sup>	3.57	0.74
Perceived ease of use	3 <sup>rd</sup>	3.69	0.82	3 <sup>rd</sup>	3.78	0.85	2 <sup>nd</sup>	3.62	0.79
Linking	4 <sup>th</sup>	3.47	0.85	4 <sup>th</sup>	3.58	0.87	4 <sup>th</sup>	3.36	0.81
Perceived effectiveness of	5 <sup>th</sup>	3.44	0.92	5 <sup>th</sup>	3.58	0.94	5 <sup>th</sup>	3.33	0.89
Participation	6 <sup>th</sup>	3.12	1.10	6 <sup>th</sup>	3.30	1.04	6 <sup>th</sup>	2.98	1.12
Confidence	7 <sup>th</sup>	2.69	0.93	7 <sup>th</sup>	2.76	1.01	7 <sup>th</sup>	2.63	0.85

45.2% (237) of respondents thought that computer games can be used to learn in a business training environment, 48.1% (252) said 'possibly' and only 6.7% (35) said 'no'. Table 5 shows the

results of the question ‘What types of skills do you think can be obtained from computer games that would be relevant to business?’.

Table 13.5: Types of skills

<b>Types of Skills</b>	<b>Rank</b>	<b>N</b>	<b>Percentage</b>
Collaboration	1 <sup>st</sup>	341	65.1%
Problem solving	2 <sup>nd</sup>	336	64.1%
Analysing	3 <sup>rd</sup>	331	63.2%
Reflection	4 <sup>th</sup>	263	50.2%
Leading	5 <sup>th</sup>	184	35.1%
Critical thinking	6 <sup>th</sup>	156	29.8%
Emotion	7 <sup>th</sup>	149	28.4%

## Discussion

The top three reasons for playing computer games were enjoyment, competition and relationship. Gender significantly influenced the reasons for playing computer games. In addition, it had an impact on the types of games they played. Males preferred to play MMORPGs, first person shooter and action games. Playing MMORPGs presented opportunities to facilitate perceptions of communications through real-time text chat. Playing MMORPGs can also be useful for learning cognitive skills in leadership and collaboration demanded in business training requirements (Mysirlaki and Paraskeva, 2012). In addition, playing shooter and action games facilitates visual perceptual skills, which acquires expertise in spatial skills (De Freitas and Griffiths, 2007). However, females were interested in puzzle, strategy and board games. It seems that these kinds of games provided a medium for delivering problem solving, analyzing, and critical thinking skills increasingly demanded in the business sector (Perrotta, et al., 2013).

The study showed the main reasons for the popularity of playing computer game for business training are relaxation, leisure and pleasure. There was a high level of acceptance amongst participants that computer games can be used in business training. In the context of Malone and Lepper's (1987) intrinsic motivation framework, cooperation, challenge and control were regarded as the important features for using GBL in business. In addition, perceived usefulness, leisure and perceived ease of use were considered as the most important factors to influence the general attitudes toward playing computer games. Most respondents believed that GBL can be successfully used in business training. This study contributes to the empirical evidence related to motivation and attitudes for using games-based learning in the Chinese hotel industry.

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## CONTRIBUTORS

### **Prof. Inmaculada Arnedillo-Sanchez, Trinity College Dublin**

Inmaculada Arnedillo-Sanchez is a professor of Learning Technologies in Trinity College Dublin and a senior researcher in the College's Knowledge and Data Engineering Group (KDEG). Her research explores theories and practices of teaching and learning to design, implement and evaluate innovative technology enhanced learning experiences and environments. Current research includes: 1. Mobile Lifelong Learning: the articulation of a conceptual framework to investigate the phenomenon, evaluation methodology for mobile learning, design and development of mLearning technologies and experiences; 2. Autism: design and development of personalised adaptive systems and multiplayer 3D games; 3. Development of Communication and Assertiveness Skills: design and development of virtual worlds for Sexual Health Education; 4. Reading: Investigation of the impact of technology in the development of reading, reading practices with technology and their impact in reading and learning; 5. Privacy and Ethics: the Big Brother phenomenon of automated usage data collection. Inmaculada is currently the PI for the Marie Curie Initial Training Network EDUWORS and for the Marie Curie CO FUND ASSISTID. Inmaculada has published more than 70 papers and book chapters. For further information on Inmaculada please see her profile <http://people.tcd.ie/arnedii>.

### **Dr. Gavin Baxter, University of the West of Scotland**

Dr Gavin Baxter is a lecture of School of Engineering and Computing in University of the West of Scotland. His research focuses on the implementation of Enterprise 2.0 social media technologies in organisations to assess whether they support the concept of organisational learning.

### **Ms. Eugenia Beltran, Graz University of Technology**

Eng, MBA-I Maria Eugenia is a senior Innovation Management consultant at INMARK Europa. Graduated in Information Systems Engineering and she holds MBA in International Management, from Thunderbird University and Socio-Economic Market Research specialization from Georgetown University. She has fifteen years of experience, providing consultancy in Information Systems deployment and Business Intelligence analysis. Maria Eugenia has extensive experience as functional business analysis, IT deployment and market segmentation and profitability analysis based in users/consumers/citizens' behavioural patterns. During last eight years Maria accrued large experience in evidence-based research, agile project management, deployment of agile methods, social and economic analysis, exploitation/impact/commercialization plans for R+I+i ICT projects at European and national level. To support these activities, she also provides technology vigilance and ICT market foresights (hardware, software & services) for different projects. Maria has participated in FP6, FP7 and H2020 projects (VIKEF, APARSEN, SMART VORTEX, SHAMAN, iSAC6, Value-IT, OKKAM, PROMISLingua, LT-COMPASS, TAG CLOUD, No One Left Behind, MLi, Rage) and development of the Roadmaps for Semantic Technologies (including Open Data and Linked Data approach). Also, she actively participates in technological platforms such as e-security, PLANETIC and the BIG DATA Association. Previously to INMARK, Maria worked in Ford Motors and Banesto/Santander Bank.

### **Dr. Helen Boulton, Nottingham Trent University**

Dr. Helen Boulton is Reader in Technology Enhanced Learning and Teaching at Nottingham Trent University, a National Teaching Fellow, Senior Fellow of the Higher Education Academy, Senior



Teaching Fellow at Nottingham Trent University and Course Leader for the Doctorate in Education. Dr. Boulton is Chair of the National Executive Committee of Association of Information Technology in Teacher Education. Dr Boulton's research is focussed on emerging pedagogy for new technologies in learning and teaching and building communities of practice to support professional development. Dr Boulton is co-investigator for two Horizon 2020 research projects: No-one Left Behind, and Managing Affective-learning Through Intelligent Atoms and Smart Interactions.

**Dr. Bryan Boyle, Trinity College Dublin**

Bryan Boyle is currently working as a Post-doctoral Research Fellow at the School of Computer Science at Trinity College Dublin where he is examining the application of 3D virtual learning environments for children on the Autism Spectrum. Over the past number of years as a researcher he has gathered experience and expertise in the use of user-centred and participatory design methodologies as applied in the development of novel and innovative ICT for people with disabilities. His other areas of research interest are in the application of technology for inclusive learning and cultural implications for assistive technology use.

**Dr. Mairead Brady, Trinity College Dublin**

Dr. Mairead Brady is an Assistant Professor of Marketing at the Trinity Business School, Trinity College Dublin. She lectures at undergraduate and postgraduate level, supervises PhD students, engages with executives through exec education programmes and also provides consulting in Ireland and abroad. Her research and teaching focuses on the role of digital technologies in marketing and their impact on marketing practice. Some of her research projects focus on data analytics, marketing metrics and social media engagement and evaluation challenges. She is a co-author with Philip Kotler, Keller, Kevin, Brady, Mairead, Goodman, Malcolm and Hansen, Torben (2016) of the popular "Marketing Management" text, which is in its 3rd edition. She is the academic lead on the online marketing plan simulation game, "MyMarketingExperience", developed with Pearson Education. She is currently conducting extensive research on the role of simulations and gaming in the third level education space, working with colleagues from the School of Education. Dr Brady has in excess of 90 refereed journal articles, book chapters and conference papers covering a range of marketing and educational issues.

**Mr. Michael Burns, Trinity College Dublin**

Michael is a Junior sophister undergraduate student at Trinity College Dublin taking the Computer Science and Business degree.

**Ms. Nathalie Cazaux, Institute of Technology Blanchardstown**

Nathalie Cazaux is Professor of French as a foreign language at the Institute of Technology, Blanchardstown. She teaches French for Business from 1st to 4th. She holds a Masters degree in French as a Foreign Language and a Masters in Applied Linguistics. She has always been interested in Computer Assisted Language Learning and the way it can help learners motivation and progress. She wants to develop language learning opportunities by integrating online games and digital interactivity in her teaching. She also co-wrote a book for French for Business with Dr Eamon Maher "Parlons Affaires" in 2001. As the secretary of the Applied French Association, she helps organisation regular CPD workshops to enhance learners second language acquisition.

**Mr. David Cline, Trinity College Dublin**

David is a junior sophister undergraduate student at Trinity College Dublin taking the Computer Science and Business degree.

**Mr. Darragh Coakley, Cork Institute of Technology**

Darragh Coakley is an E-Learning Developer in the Department of Technology Enhanced Learning having previously worked in a Cork based graphic design consultancy (Dowling and Dowling). He has been involved with a number of European projects and was project manager & coordinator of a recent transnational European project (ELM) aimed at developing the training and accreditation for the job role of a European e-learning manager, the Serious Sports project aimed at teaching basketball skills to coaches through Game-Based Learning and Green Games in Tourism and Hospitality aimed at teaching students in the Hospitality sector through Game-Based Learning. He holds a BA Honors Degree in Multimedia and a Masters in E-Learning Design and Development.

**Prof. Owen Conlan, Trinity College Dublin**

Owen Conlan is the ADAPT Theme Leader (Personalising the User Experience), the director of the Knowledge and Data Engineering Group, and the director of the Computer Science 4th/5th Year Programme.

**Dr. Charlie Cullen, Dublin Institute of Technology**

Dr. Charlie Cullen is Assistant Head of the School of Media in DIT, acting as lecturer, supervisor and principal investigator on national and European ICT research projects. Dr. Cullen has successfully completed many research projects, and has published widely in automated character animation, multimodal interfaces for location based services, data sonification, speech corpora design, emotional speech analysis and interactive online data visualisation. He has built research facilities such as the Multimodal Interaction Laboratory (MmIL), a cutting edge research facility funded by a combination of DIT, Enterprise Ireland, EU and industrial contributions that facilitates research in various key areas.

**Dr. Ann Devitt, Trinity College Dublin**

Dr. Ann Devitt joined the School of Education, Trinity College as lecturer in modern languages in October 2008. She achieved the Fulbright award in 2015 and is currently working at the University of Michigan. She teaches and supervises research in the area of language teaching and learning. She was shortlisted for the Provost's Teaching Award in 2014. She holds a first-class degree in French and Italian, a Masters in Theoretical Linguistics and a PhD in Computer Science. In industry, she has worked on machine translation and speech synthesis products in the language domain as well as cutting edge prototypes for telecommunications network management systems. Her research interests include second language teaching and learning, the use of technology to enhance education, in particular Computer Aided Language Learning and digital game-based learning, threshold concepts and reflection in teacher education and applying computational linguistic and corpus methodologies in educational and applied linguistics research.

**Dr. Pierpaolo Dondio, Dublin Institute of Technology**

Dr. Pierpaolo Dondio is a Lecturer at the School of Computing, Dublin Institute of Technology, where is a member of the Applied Intelligence Research Group. He holds a PhD in Computer Science from Trinity College Dublin and a PgD in Teaching and Learning. His main research interest is in the discipline of Intelligent Systems, including multi-agent and collaborative systems, personalization, adaptive systems and content analytics. He is recently investigating how user-

generated content can be used to teach Computer programming, and how STEM education can be enhanced by adaptive serious games.

**Dr. Claire Dormann, University of Salford**

Claire Dormann is presently a senior research fellow at the University of Salford. Most of her research is dedicated to investigating new technology for life-long learning through the design of novel forms of play and learning. Besides digital games, her specialisation includes person-centred design and user experience. Over the years, she has worked on many projects related to game-based learning, especially around affective learning and social change. Her paper “Once more with feeling: Game design patterns for learning in the affective domain” has won an award at the Meaningful Play conference, US. Her latest projects connect to the design of augmented board games and, of playful interactive experiences in the context of dementia care. She is also the leading expert in digital games and humour. She has published widely in the areas of human-computer interaction, digital games and humour. Interests include digital humanities, rhetoric and affective design.

**Prof. Joseph Eustace, University College Cork**

Prof Joseph Eustace: is the Director of the HRB Clinical Research Facility at UCC (CRF-C). The facility is co-funded by the University and by the Health Research Board and supports the design, conduct and analysis of Patient Focused Research throughout UCC and its affiliated Medical Centres. He is also a Consultant Renal Physician at Cork University Hospital. He graduated MB, BAO BCh (UCD) 1990 and undertook postgraduate training in General Internal Medicine and Nephrology in Dublin (1990-1996), Johns Hopkins University Hospital, Baltimore (1996-1999), and a NIH funded Fellowship in Clinical Epidemiology at the Johns Hopkins Bloomberg School of Public Health, (1997-1999), as part of which he undertook a MHS (Clin Epi) degree. He served as an Assistant Professor on both the Johns Hopkins Faculty of Internal Medicine and in the Department of Clinical Epidemiology and served as State Commissioner for kidney disease, Maryland Kidney Commission (2002 – 2005). He was appointed Consultant (2005) and Professor (2012) in the Department of Nephrology at Cork University Hospital and Director of the CRF-C in 2012. His research has been funded by the NIH (NIDDK), NKF and the HRB and is focused on the nutritional management of CKD and investigations into bone and vascular health in renal transplant recipients.

**Mr. Kun Fu, University of the West of Scotland**

Kun FU is a PhD student in the School of Engineering and Computing at the University of the West of Scotland. He has MSc degree from University of Edinburgh in Design and Digital Media and BSc from University of Birmingham in Tourism Business Management. His research focuses on game-based learning, serious games, and advertisements in game.

**Ms. Odette Gabaudan, Dublin Institute of Technology**

Odette Gabaudan has an MSc in Applied e-Learning and an MSc in Tourism Management. She has over 20 years of experience lecturing in French. As the President of the Applied French Association, she plays an active role in the promotion of French in third-level institutions in Ireland. Her research interest is in e-learning and in particular the integration of technology in her language teaching. She has contributed on this topic to a number of conferences in Ireland and abroad. She is currently working on the development of an integrated French grammar website. In parallel, she is the DIT local implementation leader for the National Forum funded project entitled “Enhancing Digital

Literacies for Language Learning and Teaching”. With the support of NDLR’s funding, she also developed an open educational resource for business students of French in Ireland, Travailler en Irlande.

**Dr. Eugenio Gaeta, Universidad Politecnica de Madrid**

Eugenio Gaeta (male) is Ph.D. in Biomedical Engineering from Universidad Politecnica de Madrid, Spain and Computer Science engineer from Universita La Sapienza di Roma. His expertise is in wearable sensor, physical activity monitoring, mobile Health services and Apps development. He has collaborated in several initiatives (R&D projects and collaboration with industry) in the areas of wearable devices, e-Inclusion and e-Health. Actually he is involved in the development of personalized and gamified mobile application for sports and wellness, as well as in the education environment within the Horizon 2020 project No One Left Behind (H2020-645215).

**Ms. Roisin Garvey, Cork Institute of Technology**

Roisin Garvey is an E-Learning Developer in the Department of Technology Enhanced Learning in Cork Institute of Technology. Roisin’s research interests include the use of multimedia and other technologies for education, rich internet applications, accessibility in design and how it can be used in e-learning applications. She has been involved in a number of EU funded research projects in the area of Game-Based Learning, notably the ENGAGE project and the SEGAN serious games networking project. She, along with Darragh, has coordinated the Game-Based Learning EU projects, Serious Sports and Green Games in Tourism and Hospitality EU. She holds a BA Honors Degree in Multimedia and a Masters degree for research focusing on the affordances of digital media to help children with learning disabilities in mainstream schools.

**Ms. Stéphanie Gauttier, Trinity College Dublin**

Stéphanie Gauttier is a Marie Curie ITN fellow within the EDUWORKS project, based in Trinity College Dublin, where she is investigating learning transitions and the role of technology in enhancing learning. Stéphanie is currently pursuing a PhD in Information Systems at the University of Nantes, where she is exploring the impact of augmented reality on consumer experience. She is particularly interested in the notions of enhancement and augmentation, as well as in qualitative research involving the q-method.

**Mr. Patrick Geoghegan, Trinity College Dublin**

Patrick is a junior sophister undergraduate student at Trinity College Dublin taking the Computer Science and Business degree.

**Dr. Thomas Hainey, University of the West of Scotland**

Dr. Thomas Hainey is a lecture of School of Engineering and Computing in University of the West of Scotland. His research focuses on Game-based learning, serious games, web 2.0 technologies in education

**Dr. Lucy Hederman, Trinity College Dublin**

Dr. Lucy Hederman is currently Director of the Centre for Health Informatics at Trinity College Dublin and an Assistant Professor in the School of Computer Science and Statistics at TCD, where she is currently Director of Postgraduate Teaching & Learning. A Trinity Engineering graduate, with an MSc in Computer Science from Rice University, and PhD from TCD, she has been lecturing in TCD since 1990. Dr. Hederman has been involved in Health Informatics research and teaching

for 20 years. She runs TCD's successful MSc in Health Informatics, which has produced many of those at the coalface of eHealth in Ireland today. Her research interests are mainly in clinical decision support systems. Her current research focus is on how to deliver meaningful information to healthcare workers and patients themselves, about patients' health and wellness, from the myriad streams of data which are becoming available.

**Mr. John Healy, Dublin Institute of Technology**

John Healy is Course Chair for the BA (Hons) in Game Design and an Assistant Lecturer in game design across undergraduate and postgraduate programmes in the School of Media at the Dublin Institute of Technology. He obtained his MSc in Digital Games and postgraduate diploma in Higher Education from DIT. John is currently researching across the fields of game-based learning and human-computer interaction as part the Playable Social Interactions project. Prior to joining DIT John was Head of the Games and Animation Department at Pulse College. He has worked as a game designer for Jagex Game Studios and Jolt Online Gaming on games that have been played by millions of players worldwide and continues to act as a game design consultant.

**Ms. Camille Julien-Levantidis, Trinity College Dublin**

Camille is a junior sophister Undergraduate student at Trinity College Dublin taking the Computer Science and Business degree.

**Mr. Ryan Kane, Trinity College Dublin**

Ryan is a junior sophister undergraduate student at Trinity College Dublin taking the Computer Science and Business degree.

**Dr. Evangelos Kapros, Trinity College Dublin**

Evangelos Kapros is the User Experience Lead of the Learnovate Centre, Trinity College Dublin. He is currently a Research Fellow in the Knowledge and Data Engineering Group at Trinity College Dublin (TCD), working on the user experience of education technologies, including user interfaces, APIs, and learning analytics. He is also interested in visualization in education settings and in HCI education. Evangelos's PhD research has focused on the usability and user experience (UX) of adaptive information systems. He has worked as a UX consultant for a number of clients across Europe and the Americas.

**Dr. Kathy Kipp, Trinity College Dublin**

Kathy Kipp holds a PhD in Education from Trinity College Dublin (TCD), a Master in Education: Curriculum and Pedagogy and a Postgraduate Certificate in Secondary School Teaching (English). As a secondary school teacher for ten years in America, Kathy led multiple curriculum and assessment teams. In Ireland, Kathy taught TY in two secondary schools as a part of her PhD research and has lectured for the TCD School of Education on English pedagogy methodologies and student-led learning. Kathy's PhD research focused on student contribution to the educative (student-teacher-knowledge) relationship.

**Mr. Jamie McGann, Trinity College Dublin**

Jamie McGann is a PhD student at Trinity College Dublin and primary school teacher with ten years of infant and special education experience. His research is focused on the design, development, deployment and evaluation of video games for locomotor acquisition in the classroom. He is also interested in potential causality between improved locomotor performance and improved reading

fluency in children. In 2013, Jamie completed an M.Sc in Technologies for Learning (TCD) where he was awarded a distinction and the Microsoft Prize for best dissertation. See more at <https://jamiemcgann.com/>

**Mr. Conor O’Flanagan, Trinity College Dublin**

Conor is an undergraduate student at Trinity College Dublin taking the Computer Science and Business degree.

**Prof. Maja Pivec, University of Applied Sciences FH JOANNEUM**

FH-Prof DI Dr. Maja Pivec is professor of Applied Game Design and Learning with Multimedia at the Institute of Design & Communication. Her research interests are in the field of affective and emotional aspects of human-computer interaction, with emphasis on game design, game-based learning and innovative learning approaches, and different aspects of e-learning. She is co-ordinator, scientific leader or partner in several EU or national founded projects. Her research work is published and presented at more than 100 international conferences and publications. She teaches also at the degree European Masters for EC Project Management and at the Master de Animacion at UPV in Valencia. She is editor and co-editor of four book publications in the area of innovative learning approaches. She is guest editor of eLearning Papers n43 – Applied Games and Gamification – Drivers for Change, July 2015. She was hosting European Conference on Game-Based Learning in 2009 and will be hosting the European Conference on Game-Based Learning in 2017.

**Prof. Barry Plant, University College Cork**

Prof Barry Plant: MB, BCH BAO, BMed SC, MD, FRPCI is a consultant respiratory physician, the Director of the Adult Cystic Fibrosis Centre at Cork University Hospital (CUH) University College Cork, an executive member of the Cystic Fibrosis Registry of Ireland, the current Chairman of the Medical and Scientific Council of Cystic Fibrosis Ireland, and a former national co-chair for the European Cystic Fibrosis Conference (ECFC). A University College Cork medical graduate, he dual trained in respiratory and general medicine in accordance with the Royal College of Physicians of Ireland and subsequently undertook a fellowship in pulmonary and critical medicine at the University of Washington, Seattle, with a special interest in cystic fibrosis (CF), where he remained until securing his current post in 2007. Prof Plant’s research group focuses on translational CF medicine including CF aging, CFTR modulation and the microbiome (lung and gut). Recently he was successfully awarded an FP7 award (6 million Euros over 3 years) from the EU commission, involving 12 partner sites across Europe and one in the USA. The project CFMATTERS ([www.cfmatters.eu](http://www.cfmatters.eu)) will provide a randomised, multi-centre control trial of microbiome-derived antimicrobial treatments versus current empirical therapy and explore the implications of the ‘lung-gut’ axis with serial prospective lung and gut microbiome analysis in stability and exacerbation in patients with CF. Professor Plant is widely published and recently contributed to both the ERS CF Monograph and the ECFS ‘Living longer with CF’. He has been a Principal Investigator on a wide range of clinical trials and ‘real-world’ studies in CF. He has been an invited speaker at many scientific meetings including ATS, ERS, Australasian CFC, ECFC, and an FDA meeting.

**Ms. Mariana Rocha, Dublin Institute of Technology**

Mariana Rocha is a first year Ph.D. student in School of Computing at Dublin Institute of Technology. She investigates the potential of digital games to improve engagement and academic achievements in mathematics learning. Prior to beginning the Ph.D. program, Mariana received her master in Education in Biosciences and Health from the Oswaldo Cruz Foundation, Brazil, where

her thesis examined how internet helps kids to learn science concepts. She also worked as a science reporter and editor at the Brazilian magazine “Science Today for Kids”, where she wrote texts about science discoveries for kids between 7 and 13 years old. Her research interests include digital game-based learning and mathematics education.

**Dr. Nicola Ronan, University College Cork**

Dr. Nicola Ronan: graduated from medicine in UCC in 2009 and completed her internship and basic specialist training on the cork medical scheme. During this time Dr Ronan completed her mrcpuk and mrcpi. She is currently completing a PhD in the area of cystic fibrosis as part of her ongoing training in respiratory medicine.

**Dr. Pauline Rooney, Dublin Institute of Technology**

Dr. Pauline Rooney is an elearning developer, lecturer and researcher at the Dublin Institute of Technology. She obtained her MSc (Ed) in Computer Based Learning (with distinction) from Queens University Belfast and completed her Doctorate of Education (EdD) with the University of Sheffield where she researched strategies for harnessing serious games in higher education. Her research focuses on technology-enhanced learning and professional development, and she has a particular interest in game-based learning, strategies for continuing professional development in higher education, student attitudes towards pedagogical innovation and interdisciplinary collaboration in higher education. Pauline also works as an Expert Evaluator of European Commission-funded projects in the area of game-based learning and gamification. She is a Fellow of SEDA (the UK Staff Educational Development Association) and she acts as academic reviewer for a number of academic journals including Simulation & Gaming, the International Journal of Game-Based Learning, Innovations in Education and Teaching International and the International Journal of Social Research Methodology.

**Dr. Christian Schindler, Graz University of Technology**

Dr. Christian Schindler is researcher at the Institute of Software Technology at Graz University of Technology and lecturer at FH Joanneum University of Applied Science in Kapfenberg. Before 2015 he worked 2 years as a research assistant at Graz University of Technology and 10 years in the software industry as software engineer, project- and product-manager, Scrum Master, Product Owner and agile coach in national and international projects. His research interests are agile software methods and processes like XP, Kanban and Scrum, test automation, continuous integration and -delivery as well as didactics of computer science especially the improvement of computer science education at the entry level for kids, teenagers and bachelor students.

**Prof. Wolfgang Slany, Graz University of Technology**

Prof. Wolfgang Slany is a full professor of computer science and head of the Institute of Software Technology at Graz University of Technology. Before 2003 he worked for 2 years at Tokyo University and for 12 years at Vienna University of Technology. His research interests are agile software processes and project management, in particular test driven development and Extreme Programming, furthermore teaching agile processes, as well as practical evaluation of agile methods. Other research interests include the theory as well as applications of combinatorial optimization (personnel planning, scheduling), Web- and mobile-based systems and tools, in particular for Android, iOS and mobile web browsers, as well as computer science education for kids, teens, and

young adults. He has won 14 prizes and awards related to his research and is author of more than hundred international publications.

**Mr. Jonathan Smith, National Videogame Arcade**

Formerly Chief Game Designer at Codemasters, Executive Producer at LEGO Company and Head of Production at TT Games, Jonathan Smith has worked on successful commercial videogames across many generations of hardware, from Game Boy to PlayStation 4. He sat for many years on the BAFTA Children's Committee, launched the first BAFTA Young Game Designers competition, and co-founded The National Videogame Arcade, the UK's first permanent cultural space dedicated to games and game culture.

**Ms. Bernadette Spieler, Graz University of Technology**

Bernadette Spieler is a researcher and Ph. D. at the Graz University of Technology, department of Softwaretechnology. Since 2015 she is part of the catrobat project and is working as a researcher for the European project "No One Left Behind", which is co-funded by the EU Horizon 2020 Framework Programme. Her work field includes teaching children and coaching teachers in programming, scientific research on mobile learning and constructionist gaming and coordination of different Catrobat project teams. She received her Master's degree in eHealth and her Bachelor's degree in Information management at the University of Applied Sciences FH JOANNEUM in Graz. In this area she has dealt intensively with the subject of digital diagnostic assessment, database systems, business management, project management, software development, design, marketing and usability testing. She gain practical experience as a freelancer dealing with eGovernment issues at the Styria's Government. Through this job she has obtained knowledge in planning, implementing and evaluating software projects.

**Dr. Sabin Tabirca, University College Cork**

Dr Sabin Tabirca: graduated from Faculty of Mathematics of University of Bucharest with a 1H degree in Informatics. He obtained his PhD in 1998 from University of Brunel for studying new sequential and parallel methods for the maximum flow problem. He served as an assistant professor, lecturer, senior lecturer and associate professor in the Computer Science Department of Transylvania University of Brasov for more than 10 years. In 2000, after a short post-doctoral stage in University of Manchester, Dr Tabirca moved to UCC as a lecturer in Computer Science. Since 2010 Dr Tabirca holds a position of senior lecturer.

**Dr. Wee Hoe Tan, Sultan Idris Education University**

Formally a 3D animator, Wee Hoe joined academia in mid 2004 to teach and develop multimedia courses in Kuala Lumpur University (UniKL), Malaysia. After teaching for 3.5 years, he left UniKL for Sultan Idris Education University and then pursued a PhD at University of Warwick for three years. Towards the end of his doctoral study, he began to work as a consultant in the game industry. He involved in the game coaching system design of the FPS Trainer project in Dundee, UK and the game- based learning system design of the KNeoWORLD Project in San Francisco, US. He is currently conducting research into educational games design, development and validation. Apart from being the Director of UPSI Education Research Laboratory, he is also an Associate Professor in Creative Multimedia Department. He is an accreditation panel of Malaysia Qualification Agency, a certified Level 3 MATRIZ practitioner, advisory panel of Malaysia Game Development Cluster, and the vice president of Serious Games Asia Society, which is based in Singapore.



**Prof. Brendan Tangney, Trinity College Dublin**

Brendan Tangney is Professor in Computer Science in Trinity College Dublin, the University of Dublin. He is co-director of Trinity's Centre for Research in IT in Education (a joint initiative between the School of Education and the School of Computer Science & Statistics) and has held visiting positions in the Universities of Sydney and Kyoto. He is a recipient of a Provost's Teaching Award for Excellence and Innovation in Teaching & Learning. Brendan is also the academic director of Trinity's Bridge21 project and is a member of the Editorial Boards of Computers & Education and the AACE Journal of Computers in Mathematics & Science Teaching.

**Ms. Chrysanthi Tseloudi, Trinity College Dublin**

Chrysanthi Tseloudi is a Research Assistant and Marie Curie ITN fellow within the EDUWORKS project, based in Trinity College Dublin. She holds a Master's degree in Informatics, with a specialization in Information and Communication Technologies in Education, obtained in Aristotle University of Thessaloniki. Chrysanthi is interested in the research and development of flexible educational technologies that motivate, engage and enable learners to assume an active role and enjoy learning. Her current research focuses on exploring mobile learners' technology usage and daily activities to determine how technology can facilitate their lifelong learning transitions.

**Ms. Tamara Vagg, University College Cork**

Tamara completed her primary B.A. in Visual Communications in Waterford Institute of Technology in 2012, she went on to complete her Masters in Interactive Media in University College Cork, Tamara's MSc project was proposed by the CFMATTERS research group and specialised in visualisation and simulation for the education of Cystic Fibrosis. Following on from this, she began her PhD in 2014 under the supervision of Dr. Sabin Tabirca of UCC and Professor Barry Plant of CUH, and is currently working on developing her MSc research further through this. Tamara has particular interests in patient education and 3D visuals and simulation. These interests extend to include educational and digital content for other areas of the medical industry.

**Ms. Yuan Yuan, University of the West of Scotland**

Yuan Yuan is a PhD candidate in Communication, Hong Kong Baptist University and Adjunct Associate Professor in Beijing Normal University Hong Kong Baptist University United International College (UIC) Zhuhai. She received a MSc in Design and Digital Media from the University of Edinburgh and a MSc in Communication, Advertising and Public Relations from the University of Ulster. The research areas include media psychology, media effects in the digital age, media use and communication behavioral on the Internet, and game studies.

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