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Presented version deposited in CURVE July 2013

Original citation & hyperlink:

Lameras,P., Petridis,P., Dunwell,I., Hendrix,M., Arnab,S., de Freitas,S., Stewart,C. (2013, May). *Game-based approach for raising awareness on sustainability issues in public spaces*. Paper presented at the Spring Servitization Conference: Servitization in the multi-organisation enterprise, Aston Business School, Birmingham.

<http://www1.aston.ac.uk/aston-business-school/research/events/ssc2013/>

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A Game-based Approach for Raising Awareness on Sustainability Issues in Public Spaces

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ABSTRACT

The paper reports on the ‘Sustainability Game’ evaluation with computer science university students as means of understanding their experiences and conceptualisations of sustainability issues in public spaces. Deployed targeted questionnaires with 33 students in UK, the game’s evaluation demonstrated that a conceptual change may be implemented in relation to how sustainability has been experienced before engaging with the game. A questionnaire with 20 questions was distributed to students for evaluating various elements of the game such as usability characteristics, accumulation, assimilation and consolidation of new knowledge patterns related to the educational-based features of the game with an implicit focus on whether the game can be integrated within an academic setting. The overarching conclusion from the analysis of the game uptake is that it may enhance student’s engagement with sustainability issues, especially in blended learning contexts for ‘blending’ different pedagogical approaches with tools and media as means of improving the educational practice.

Keywords: serious games, sustainability, public spaces

1 INTRODUCTION

Promoting learning through public participation is key element in raising awareness regarding the sustainability of open public spaces among university students and professionals (e.g. engineers, architects, planners and public authorities). Traditionally, sustainability issues for urban cities are predominantly addressed through decisions and actions performed by local authorities in consultation with experts in designing, implementing and sustaining public constructions. It is, therefore, essential that tools are developed which support students in learning issues, policies and practices in designing and sustaining public spaces in collaboration with specialists in the field. The outcome of this is twofold: Firstly students are able to enhance their knowledge on sustainability issues through applying and transferring content knowledge in real world contexts; and secondly a direct contribution is achieved towards improving a designated public space.

From a European perspective, the sustainable city debate is increasing, featuring as a prominent issue in several policy documents of the European Commission such as the EU thematic strategy on Urban development (EC, 2006) and the report of the BioRegional Development Group and the Commission for Architecture and the Build Environment (2008) of “What Makes an Ecotown”. Since the purpose of the planning system is to contribute to sustainable development as means of addressing the linked challenges of climate change, resource use, economic prosperity and social well-being, the creation of links and relationships between students and professionals may allow the communal implementation of sustainable

design and construction at the scale of open sites and parks in urban areas. Sustainable design and construction takes into account the resources used in construction as well as the environmental, social and economic impacts of the construction process itself, and how buildings are designed and used (National Planning Policy Framework, 2012). Such European policies and guidelines aim to contribute to the enhancement of sustainability in three overarching ways: (1) elaborating further the issue of sustainable cities with special focus on public open spaces, whilst taking into account the views of professional planners and architects; (2) enhancing learning about sustainability among university students and (3) promoting the active involvement of students in planning and urban design for public spaces such as parks. This brings to the fore the emerging theme of improving local governance standards by involving students and other citizens in local decision making for promoting local democracy and community cohesion.

Such approaches draw on collaborative processes and practices to broaden existing sustainability designs and construction principles through participatory and student-centred approaches to learning, which allow students to experience the process of planning and constructing urban spaces in a technologically-rich way. Although traditional methods of sustainable design and construction principally involve face-to-face interaction between the parties involved, technology-based interventions may exploit blended approaches, reducing the need for such interactions.

This paper explores the use of a serious game to address these issues, which predominantly focuses upon promoting awareness whilst raising interest among students and professionals in the evaluation of sustainability as part of improving the quality of life in urban cities. In the following section, the state-of-the-art in game-based learning is linked to the issue of teaching and learning about sustainability in urban cities, leading to the description of the 'Sustainability Game' approach¹ in Section 3. An analysis of the game in terms of user engagement and its potential to be used in an academic setting is then provided in Section 4. The results analysed were obtained by eliciting players' experiences of playing the game through 20 semi-structured questions, in a small-scale survey carried out during 2 piloting workshops. The overarching conclusion from the analysis of the user engagement and efficacy of the game for use as a learning tool within an academic setting is that the game may enhance student's engagement on sustainability issues, especially in blended learning contexts for 'blending' different pedagogical approaches with tools and media as means of transforming the educational practice.

2 BACKGROUND

The Commission for Architecture and the Built Environment (CABE)² principally promotes the importance of urban design and has a central tenet to incorporate the principles of sustainable development into all aspects of urban design and planning. The quality of public spaces plays a major role in the economic, social and environmental sustainability of our cities. The benefits of well-designed and managed public-space include encouraging social interaction and community cohesion as well as a more outdoor lifestyle, reducing stress levels and adapting to a change climate (CABE, 2008). In line to this, public spaces are vital assets that would need to be designed and managed more flexibly in future. Local authorities may improve the quality of public spaces by developing public realm strategies, appointing public space champions and regenerating streets as active and comfortable spaces.

CABE's report³ focusing on ordinary places argues that while city centres have improved beyond recognition over the past ten years, many ordinary places still suffer from inefficient commercial development. Compulsory training in public participation for architects, planners and other build environment professionals seems to be important for creating a sense of participation and collaboration

¹ <http://aspisgame.i-maginary.com/EN/home/index.html>

² www.cabe.org.uk

³ <http://webarchive.nationalarchives.gov.uk/20110118095356/http://www.cabe.org.uk/files/ordinary-places.pdf>

with the wider community. The report also recommends teaching all young people is a key strategy for being able to articulate what they think about a place, how it works and what would make it better. In CABE argue that in order to achieve a conceptual and realistic change on how public spaces are being planned and constructed, universities need to address sustainability issues more constructively in order for students to consolidate all the various processes and practices.

Barton (2000) examines the practicalities of reinventing neighborhoods. In particular the nature of local communities is examined for building social capital. The focus is on ordinary localities in which people actually live, examining the changing nature and role of local place communities to develop a fresh perspective on the planning and design of neighborhoods in urban areas, based on the eco-system approach. A more recent study from Thompson and Travlou (2009) analyses the nature and value of people's access to outdoor environments, offering a useful insight into people's engagement with open spaces and thereby recommending the key criteria for sustainability such as engaging the community and users in the design of public spaces and promoting dialogue between city council/planners with citizens as means of explaining the city's plan and the challenges faced.

2.1 Game-based learning

Learning is mostly a process that leads to a change in behaviour or understanding, rather than a quantitative increase in knowledge or storing information that can be reproduced. Learning is about internalisation (I. Nonaka, 1991), i.e. about making sense or abstracting meaning, about being able to relate parts of the subject matter to each other and to the real world. Several methods and approaches exist to learning (e.g. collaborative, cooperative, contextual, discovery-based, problem-based etc), each with its strengths and weaknesses which make it more or less suitable for specific application settings.

Over the past few years, with the widespread use of commercial games the domain of game-based learning has received increasing attention. However, until very recently strategies for supporting the more efficacious methods of learning with games were uncertain. Research has shown that teachers were unsure which games to use, which context to use games and how they could be evaluated and validated (de Freitas & Oliver, 2006). Work coming out of these studies led to the development of conceptual frameworks that were then used over the next few years for testing game-based learning. In particular the four dimensional framework with its four dimensions of the learner, pedagogies used, the representation of the game itself and the context, allowed researchers to evaluate serious games and to interrogate what metrics and measures could be used both to validate game-based learning, and to support the learning design process.

Studies that compared traditional learning and game-based learning (S. Jarvis & de Freitas, 2009) found significant difference in favour of game-based learning. Studies in the US have also confirmed this finding (e.g. T. Mautone, Spiker, & Karp, 2008). Empirical studies reflecting the efficacy of game-based learning providing greater support for developing effective games for learning, and addressing user expectations of high fidelity games and 'immersive experiences' (de Freitas & Neumann, 2009).

Some of the main strength of game-based learning includes motivating of learners and the ability to provide personalised approaches to be modelled for individual users and user groups. However, studies have opened up the importance of games as tools for supporting socially based learning, or social interactive learning (e.g. de Freitas & Neumann, 2009; de Freitas, Rebolledo-Mendez, Liarokapis, Magoulas, & A., 2009).

The benefits of effective use of game-based learning are considerable, but as studies have shown use is often most effective with particular learners who enjoy learning with games (S. de Freitas, 2006; de Freitas, Savill-Smith, & Attewell, 2006) and therefore its most effective use may need to be differentiated accordingly to learners' specific requirements (e.g. according to learning level, competencies and skills).

3 THE SUSTAINABILITY GAME

The game contains an overall mission, focusing on public participation and negotiation, which is structured into quests, implemented by short, simple mini-games (Figure 1). Through the mini-games the player gets introduced to the process of urban planning, the design of sustainable spaces and the participation of citizens in this process.



Figure 1: The sustainability game structured into 8 quests implemented as mini-games.

The player steps into the role of Peter - a first year architecture student, who turns to his professor for help in solving the problem of his brother Larry. The decision to demolish the skating wall in the public park appeared to be only a small part of a bigger problem. Seeing Peter's interest and passion towards this cause, Professor McNutty challenges him to get involved in the redesign of the public park and offers to guide him through a series of short quests leading to the final goal which is to pitch the idea to the City Council. Each quest is presented to the player from McNutty in the form of an email screen-shot addressed to Peter. The aim of the first quest is for the player to understand needs of multiple users and identify park user groups. In the second quest, the player meets various people in the park for extracting information as a way of collecting as many correct suggestions as possible within a given time and match them with the needs that have been collected in quest 1. In the third quest the player's goal is to identify problems related to the current state of the park by clicking on pictures and classifying them under the correct category in the inventory. In the fourth quest, the player is directing as many people as possible by offering them flyers for launching voluntary maintenance schemes for planting trees and cleaning the park. In the fifth quest the player's goal is to raise awareness around the design of sustainable spaces and recruit more park users by collecting their signatures. In the sixth quest, the player selects the top three needs that must be realized in order to satisfy maximum park users. A 3 by 3 matrix puzzle is developed in which each square represents a particular need. The player must arrange the squares such that each line in the matrix lines up to reveal one area of conflict.

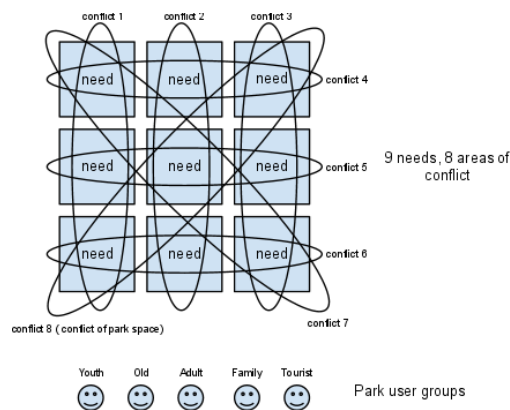


Figure 2: Nine needs that can be arranged to give rise to eight areas of conflicts.

4 METHOD

This section provides an overarching analysis of the game questionnaire that was provided to computer science students, during 2 workshops organised in Coventry, as means of understanding their experiences, approaches and overall evaluation of the ‘Sustainability Game’. The findings suggest that the game is more akin to be used for educational purposes as it enhances content and process related knowledge with regards to sustainability hence it encompasses pedagogically-rich elements which afford the alignment between teaching and learning strategies, assessment methods and learning goals. The evaluation was implemented with undergraduate (UG), postgraduate (PG) and doctoral students (n=33) studying computer science at Coventry University, UK (see table 1). Students completed a small-scale questionnaire with 20 questions for evaluating various features of the game such as usability characteristics, accumulation assimilation and consolidation of new knowledge patterns related to the subject-based features of the game.

Contextual elements	Description
Country	Coventry, United Kingdom
Place of the event	Serious Games Institute
Date	26 April 2012; 14 September 2012
Target group	UG, PG and PhD students
Number of participants	23 (26 April); 10 (14 Sept) n=33

Table 1: Contextual elements of the ‘Sustainability Game’ evaluation.

Against this background, a brief presentation was given to students with the propensity of introducing the scope of playing the game as well as the adoption of the game-based learning approach in enacting sustainability in an open and collaborative way. Furthermore, an overarching demonstration of the game aided to immediately grasp basic functionality, as all students were familiar with computer-based environments and simulation tools and especially in the development and use of games for educational purposes. Students used the game through laptop and desktop computers installed in a dedicated state-of-the-art facility especially designed for educational related purposes with large screen panels and immersive learning spaces for collaborative and game-based learning. Students then completed the questionnaires informed by their experiences and actions of using the game.

5 DISCUSSION OF RESULTS

From the summary of the questionnaires, it seems that computer science students tend to perceive the game as intuitive, fun and immersive for understanding an array of aspects and issues of sustainability beyond traditional face-to-face teaching. This is advocated through the question that asked to students whether their knowledge has been improved after playing the game (see figure 3). It was clear from students’ responses that their knowledge has been improved through personal construction of meaning resulting from their interactions with the virtual environment (see figure 3). From this perspective students experienced that different cognitive patterns of sustainability could be made explicit through the game and thus it created opportunities to explore sustainability ideas and test their robustness in explaining relevant phenomena, accounting for events and making predictions. Although, however, most of the students reported that they did not have any prior experiences in sustainability and ways of improving it through public consultation and co-creation of ideas, they felt that fragmented information gained on sustainability issues mainly informed through discussions with family and friends helped them

to understand basic meanings and to transform them to cohesive information that could be consolidated and assimilated to knowledge. Students also highlighted the feature of listening, considering and understanding other peoples' views on sustainability, which seemed to be of a paramount importance for valuing other's people needs and circumstances. For example, they felt that the dialogue between them and the different avatars within the game created a dialogical process that recognised awareness, knowledge and understanding are constructed when individuals engage socially in discussions and activities about shared tasks and problems. This observation open a window for studying and exploring particular forms of collaboration in games (between physical and virtual characters) that may support students in gradually mastering some of the practices and norms that characterise collaborative knowledge creation within games. Recognising that the students have constructed their current understandings from their previous experiences, they felt that their knowledge was usefully related while playing the game. This may imply that the game allowed students to apply their knowledge to new contexts, through which students may generate, new questions and new investigations and thereby transfer of learning may occur.

Students stated that the level of human-computer interaction was in a satisfactory level and natural promoting a sense of developing a virtual community between them and the virtual characters; while through gathering an interpreting their requirements (mainly in the 1st and 2nd quest) they could work together to address the different challenges. Furthermore, students felt that the game was immersive enough to keep them interested throughout the quests although some additions and/or improvements might be necessary in the richness of the animations or around the area outside the park which does not have many events and/or interactions to explore.

In general terms all students would recommend the game to fellow students and friends as it was conclusive that they have never realised that sustainability is a key element for improving quality of living in large cities. In summary, the game felt natural and responsive, consistent with academic learning and would be probably introduced to friends and family and/or would be played again (see Figure 3).

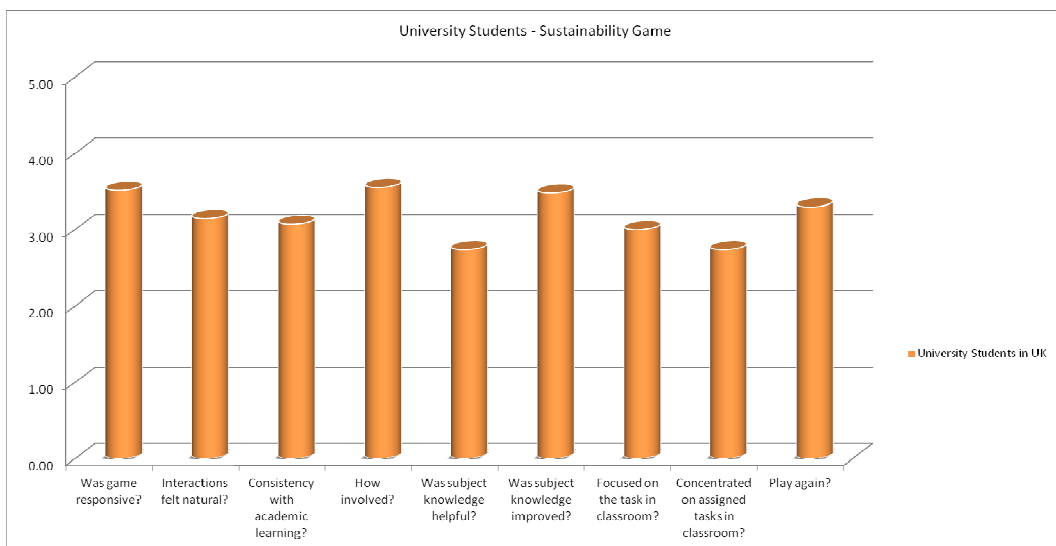


Figure 3: University students responses to survey questions.

6 CONCLUSIONS

The findings of the game evaluation have provided broad pointers to a wide range of considerations that should inform the practical implementation of the serious game in an academic setting. Against this background, the Sustainability Game seemed to be more pervasive for academic teaching and learning as

it provided the foundations for actively constructing knowledge resulting from student's interaction with the virtual world. Moreover, the interaction with the virtual characters created the triggers to actively participate in completing the different quests as well as to identify and connect prior knowledge with new information that aid in creating meaningful learning. The Sustainability Game is a useful tool for accumulating, consolidating and extending knowledge in sustainability within an academic environment because:

- It provides experiences, materials and sources of information for students to use directly from the virtual environment (Quest 1).
- Students may act in response to the different tasks required, showing the use of instruments necessary for completing a quest (Quests 1 and 2).
- Students may test their ideas or answer their questions through diverse ways of investigating and exploring a plethora of sustainability phenomena that take place in all quests.
- It facilitates integration of different learning quests, paths and objectives that have complementary tools which allow students to take different pathways towards solutions (All quests).

Since the Sustainability Game encompasses the use of technology and media to promote learning, we propose that it could efficiently be used in a 'blended learning' context, which blends different pedagogical approaches with tools and media for transforming the educational practice. The teacher may act as facilitator of the game process. The element of multi-player collaboration could be added in further iterations of the game, probably in more advanced modules (for example in masters courses or for collaborative research) where students are motivated and self-directed to value collaborative processes as an approach that enhance their learning patterns through learning from more capable peers (Vygotsky, 1978). Face-to-face and online discussion processes could take place before, during and after playing the game for resolving problems, allowing students to take the time to explain their thinking of sustainability and thus to improve their understanding through engagement with evidence from their own experience.

ACKNOWLEDGMENTS

This work has been supported by the European Commission under the collaborative project ASPIS "Auditing the Sustainability of Public Spaces" funded by the European Commission under the Life Long Learning Programme KA3 Multilateral Project, Grant Agreement 2009-11805. Also this work has been supported by EPSRC Grants Ref EP/K014064/1, EP/K014072/1, EP/K014080/1 'Transforming the adoption of Product -Service Systems through innovations in applied gaming technology'; a joint project with Aston Business School, the Advanced Manufacturing Research Centre, University of Sheffield and the Serious Games Institute, Coventry University.

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