Public engagement through the development of science-based computer games: The Wellcome Trust's "Gamify Your PhD" initiative

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Commentary

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Abstract

New developments in digital technologies are enabling scientists to explore novel avenues of engagement beyond face-to-face approaches. 'Gamifying' science through the creation of computer games based on scientific research is part of this trend. Recently, the Wellcome Trust held a competitive 'hackfest' called 'Gamify Your PhD'. Six finalists were selected to develop their research into a computer game with the help of professional games developers. I was able to observe this event with the aim of exploring the collaboration between scientists and games developers, and how science-based computer games can be used to engage the wider public.

Key Words

Computer games, gamify, public engagement, biomedical sciences, hackfest

The development of online science engagement

Institutions involved in scientific research regularly seek to communicate and engage with citizens beyond their walls. Public engagement encompasses a number of different activities within specific contexts and with definite aims (Davies, 2013). Some activities

focus on education or inspiring a broader interest in science through events such as public lectures or science festivals. While other activities seek to increase public participation in science, for example, by addressing societal concerns in order to inform public policy, or by opening up scientific research to 'citizen scientists'. Public engagement activities may attempt to increase the accessibility of professional scientists, and 'connect' people with science in some way.

The development and widespread adoption of Web 2.0 technologies, tools and platforms have created new opportunities for public engagement (Blank & Reisdorf, 2012; Holliman, 2008). This is demonstrated by the proliferation of science blogs, science-based podcasts, and online citizen science projects such as GalaxyZoo[1] and Foldit[2] that have given citizens the opportunity to help solve real-world research problems (Birch, 2010; Hand, 2010).

A number of institutions involved in the public communication of science, such as the Wellcome Trust, the UK's Royal Institution, and the Science Museum in London, have recently turned to computer games to bring science to a potentially large audience without the need for physically attending an event[i]. Computer games now rival television and films as a source of entertainment, with millions of active gamers around the world (Spence & Feng, 2010). They appeal to a wide range of individuals, and it is evident that the existing gamer stereotype of a young adolescent male is no longer accurate in (ESA, 2012; IAB, 2011).

'Gamify Your PhD'

As part of the Wellcome Trust's exploration of gaming as a vehicle for public engagement, an initiative was launched in July 2012 called 'Gamify Your PhD'. The organisers invited current and recent students in the biomedical sciences or medical humanities to submit proposals outlining how their area of research could be transformed into an entertaining

[1] www.galaxyzoo.org
[2] www.fold.it

computer game[3]. Six finalists were selected from approximately sixty applications. Games developers were also invited to take part, and six companies were selected to partner the students. The event took the form of a competitive two-day 'hackfest' in early September 2012. Each team (which was composed of four-to-six individuals) was given two days to develop a game that was based on the student's PhD research.

At the end of the two-day period, each team gave a presentation where the game was demonstrated and the underlying science outlined. The game deemed to be the most successful by a panel of reviewers[4] received funding from the Wellcome Trust to develop the winning idea further, with a view to launching the game publicly. This funding would cover approximately five more days of full-time development. The organisers hoped the event would provide "a great example of what can be achieved when games and science meet" (Wellcome Trust, 2012).

Observations of the hackfest

I asked if I could attend the hackfest as an observer. My main aims while attending this event were to investigate how scientists and games developers collaborated, and whether there was a 'trade-off' between scientific accuracy and entertainment. I was also interested in exploring how games could engage the player, and if they could go beyond educating them.

As an observer, I was not directly involved in any of the deliberations or discussions relating to the development of the games. I did make field notes on how the groups worked together, what aspects of the development were key or problematic, and how the approaches differed between the groups. I had brief discussions with the scientists concerning their views toward the public engagement of their work in general, and how games may fit into their wider engagement activities. I also had discussions with some of

[3] http://www.wellcome.ac.uk/News/Media-office/Press-releases/2012/WTVM055859.htm

[4] The panel of reviewers comprised of a senior scientist from the Wellcome Trust, the editor of wired.co.uk, and two professional games developers.

the developers to ask them about some of the challenges involved in developing a game based on actual scientific research.

From observing the initial discussions between the scientists and the developers, it was clear that the main challenge was going to be the successful integration of science within a suitable gaming environment. A balance had to be struck between the level of scientific detail and accuracy, and making the game entertaining and fun. Decisions had to be made early on with regard to the level of complexity of the game, and how much scientific information was incorporated into the game design or tutorial. Once these decisions were made, the developers set to work on the design, graphics, and game mechanics. In a couple of the groups, initial ideas for the game had to be abandoned, as the game concept simply did not fit with the scientific remit. Processes had to be simplified to keep the level of complexity manageable, and to create a game that was easy to comprehend. The scientists remained closely involved in helping to guide this aspect of the development. Indeed, one of the aims of the organisers was to 'embed' the scientists within the development phase and not have them acting as 'external consultants' (Story, 2012).

From my discussions, it appeared that none of the scientists had used games as an engagement tool before. A few of them played games themselves and all were open-minded as to the potential of games to communicate their area of scientific research (hence their involvement in this event). Five of the scientists were involved in biomedical science on a molecular and genetic level, while one scientist was researching an area of medical ethics relating to the treatment of addiction. Several of the games developers had worked with the Wellcome Trust previously, so had some experience of developing games based on scientific research.

The games

The overall winner of the event was a 'shoot 'em up' game based on intestinal immunology and represented a struggle between 'good' and 'bad' bacteria called 'Dysbiosis'. In this

game, the player controls a collection of cells that form the intestinal wall, and must shoot harmful bacteria, while letting 'good' bacteria though. This was selected as it was deemed to have the best potential for incorporating scientific information into an entertaining games package. The first runner up was a game that focussed on RNA transcription in a species of yeast ('Monsieur Baguette presents…RNA transcription of Saccharomyces Cerevisiae'). This is a pattern matching game where the player must incorporate the correct molecules within a growing chain of RNA in a yeast cell. The second runner up was a game based on cellular metabolism in the malaria parasite ('Simalaria'). This team managed to reduce a metabolic network with nearly 1000 connections to one with just five important reactions that the player controls in order to create the greatest number of offspring during the parasite's lifecycle.

The other games included one based on the lifecycle of Campylobacter jejuni ('Campy Command') which follows the pathogenic bacterium as it travels from its initial host (a chicken) to a human host. The player must collect amino acids as an energy source, and then gather protective enzymes to protect itself in the human gut.

Another finalist produced a game that differed in its approach to the others. Instead of being based upon a specific area of scientific research, it was based upon the processes associated with carrying out experimental work in the lab. Called 'Lab Hero: Womb for Improvement', this game was based on experimental procedures for collecting samples of uterine tissue (the scientist in this team was researching the genetic basis of complications in labour and childbirth). Scores were awarded for the number and quality of samples produced. The game was based very much on the personal experience of the scientist, and provided an elegant example of how the research process and scientific method could be communicated and shared.

The remaining finalist produced a game that was based on an area of medical ethics relating to the treatment of addiction. In the 'Ulysses Contract', a quest-based game, the player

must navigate their way through a hostile environment that simulates the road to addiction recovery. The game itself is centred on a philosophical consideration of 'free will' and incorporates a treatment approach called the 'Ulysses Contract' not currently used in the United Kingdom. This is similar in principle to a 'living will' and allows an individual to dictate a future course of treatment, should they be unable to make a rational and fully informed decision about it at a later date (*e.g.* during a relapse into addiction). This work was interesting as it took a potentially controversial topic which at a first glance may have seemed impossible to 'gamify', and created a game with the potential to stimulate dialogue, for example between patients and doctors during a course of treatment. The scientist with this group felt that games had the potential to be used to stimulate dialogue within society about controversial issues such as euthanasia, or abortion, in a non-confrontational way.

While there was only one overall winner, the other finalists were strongly encouraged to apply to the Wellcome Trust for funds to develop their games further[5].

Science games and public engagement

This was the first time an event of this nature had been held by the Wellcome Trust, and one of their aims was to create games that 'engage' rather than just educate, although it was not made explicit by the organisers what was meant by 'engage'. All of the games developed could be described as educational in some way. Each had a tutorial that outlined the basic scientific concepts for the player, and some understanding was required in order to play successfully.

Without a more formal and in-depth assessment of the games, or the experiences of players, it is difficult to fully ascertain how these games may go beyond educating. However, one could speculate that in general, scientific games could inspire a player to feel more connected to science, or to the process of scientific research. Particularly if a game is based

[5] The six games can be viewed and played here: http://www.wellcome.ac.uk/Funding/Public-engagement/Funded-projects/Major-initiatives/Broadcast-media-strategy/Gamify-Your-PhD/WTDV033976.htm

on an actual research project and a connection can be made to the scientists undertaking the research.

Scientific games could also be used to promote discussion about ethical issues associated with research (*e.g.* 'The Ulysses Contract'), or to inform public debate (*e.g.* 'Campy Command' could be used in discussions relating to food safety). In this way, games may serve as a stimulus for increased dialogue or contact with the scientific community. They could be used as part of formal dialogue events, as well as in science festivals or open days. Indeed, dialogue opportunities could be self-contained as online social platforms (*e.g.* player forums) could be incorporated, thus enabling players to discuss any issues that the game raises either with each other, or with scientists.

There are some games that have clearly demonstrated the potential for engagement beyond education by facilitating interaction and collaboration between scientists and the wider community (Cooper, 2011; Gross, 2012; Kawrykow et al., 2012). For example, Foldit is an online game that attempts to solve a real-world research problem, elucidating the 3-dimensional structures of proteins. This game was developed at the University of Washington in a partnership between biochemists and computer scientists specialising in game design. Participants work either alone or in teams to come up with the most likely structure for a given protein. The game is structured as an interactive three-dimensional puzzle. Possible 'solutions' to a puzzle are followed up by the scientists, and in a number of cases, significant scientific breakthroughs have been made. For example, two teams of Foldit players were instrumental in 'solving' the 3-dimensional structure of an enzyme relevant to HIV infection – a problem that had confounded biochemists for the best part of decade (Khatib et al., 2011) .

Foldit has demonstrated that science-based games not only present an opportunity for public engagement, but that they also offer a real opportunity for collaboration between scientists and non-scientists. Non-specialist participants bring skills such as puzzle-solving abilities, or

three-dimensional spatial awareness that can be directly applied to scientific problems. Such skills cannot be easily mimicked by a computer. Foldit and games such as Phylo[6] and EteRNA[7] offer citizens an experience of authentic scientific research. Indeed, this may be one of the most interesting and fruitful ways that computer games may be used in the public engagement of the sciences.

However, while Foldit and games like it offer a way to actively engage with a small sub-set of non-specialists in scientific research, they require a significant investment of resources to develop and maintain, and may not be suitable for all areas of scientific research. As a result, they may not be a realistic option for some scientists.

The potential of scientific games

The finalists in the Wellcome Trust hackfest have demonstrated that given the right expertise, scientific research can be developed into computer games that are fun to play in a relatively short period of time. While it appears that one of the main challenges associated with using games may lie in producing a product that goes beyond educating the player, the games at the hackfest have potential for use within a wider engagement context. For example, they could stimulate discussion about a particular ethical or health issue, or they could bring an external audience closer to the actual processes associated with research. By incorporating online social applications, interaction between scientists and players could be facilitated, thus helping to increase the 'accessibility' of science and scientists.

One of the main advantages in using computer games in public engagement is the fact they may be readily accessible with a PC or mobile device. One could play these games at any time, at home or while on the move. Engagement experiences are therefore no longer restricted to face-to-face events that may be held only occasionally, or at time and place that

[6] http://phylo.cs.mcgill.ca/beta/

[7] http://eterna.cmu.edu/web/

are not always convenient. A game may also have a broader reach, and could potentially have a larger audience than an open day at a research institution.

While there exist a number of challenges, computer games may offer scientists significant opportunities to communicate and engage with the wider community, and to make use of new digital technologies in a creative and entertaining way.

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[i] **See the following websites for examples of scientific games from these UK institutions**.

The Wellcome Trust in collaboration with Channel 4 Education: http://www.wellcome.ac.uk/Education-resources/Teaching-and-education/Big-Picture/All-issues/Genes-Genomes-and-Health/WTDV027163.htm;
The Royal Institution: http://www.rigb.org/contentControl?action=detail&section=rt&rt=55&gclid=CLC6yI6NsrICFUdvfAodBD0ATg;
The London Science Museum: http://www.sciencemuseum.org.uk/onlinestuff/games/