Design of an Immersive Online Crisis Preparation Learning Environment

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ABSTRACT

This paper describes the design and development of an online immersive learning environment focused on supporting the general public in awareness of, and preparation for, crisis situations. The system developed uses the PANDORA$^+$ training environment, and integrates prior research work carried out on eLearning and Crisis Management. Specifically, it pulls together the outputs of three European funded research projects, described in the paper, which provided the authors with a rich multimedia, immersive training environment for crisis managers, experience in the management and support of a large, distributed learning exercise through a MOOC, and extensive survey information on general population awareness of crisis responses and attitudes to crisis preparation. Based on these outputs, the authors are using the PANDORA$^+$ training environment both as a field event support tool and as a MOOC platform, to support large-scale general public crisis preparation training.

Keywords

Online Learning, Crisis Preparedness, MOOC

INTRODUCTION

The work described here brings together research encompassing the provision of, and support for, training for stakeholders involved in crisis management, the focus being to make well-formed and easily accessible training materials available at relatively low cost, to improve the quality of public and professional response in crisis situations. The research brings together outputs from three EU funded projects in the design and development of an online vehicle and training materials to help develop population awareness. The projects are, Pandora (2012), dCCDFLITE (2015) and POP-ALERT (2016), which is the focus of the work currently being described here. POP-ALERT is an EU FP7 project involving eleven partners from seven countries across Europe. Its focus is the preparation of societies and populations to cope with crises in a rapid, effective and efficient way. The POP-ALERT team has undertaken a thorough review of the literature on approaches, population behaviours, first reaction strategies, awareness of risk etc. The focus of this work is not only on local populations but also vulnerable groups, such as tourists, expatriates, the elderly and refugees, and the effectiveness of the use of messages, audible alarms, pictograms etc. on these population groups. The project has generated a framework encompassing a variety of tools and techniques to enhance population awareness, and will conclude with local and distributed field studies to test the effectiveness of this framework.

To support the field studies in POP-ALERT, the authors are utilising a bespoke version of Pandora$^+$ (2016) ([1]*Bacon et al,* 2015), which is the enhanced development of a product called Pandora (*Bacon et al* 2012, MacKinnon et al 2013), one of the key outputs from an earlier EU FP7 project. Pandora$^+$ is an immersive, rich multimedia, training environment initially designed to provide realistic training for strategic level crisis managers, who, in the event of a crisis, need to work together to come up with a plan of action and take decisions as the crisis situation unfolds. The Pandora$^+$ system is not however specific to crisis management, it is

a sophisticated environment into which a wide variety of scenarios can be uploaded and executed. It is an event network system, which presents trainees with a series of events that occur within a specified timeline, and requires them to make decisions about what to do at specific points on that timeline. The level of immersion achieved by trainees is a product of the realism of the scenario presented, and the quality of the supporting materials.

The Pandora+ environment is planned for use in three trials during Spring 2016: 1) Lisbon, which will simulate an earthquake disaster; 2) Corsica, which will simulate a forest fire disaster; and 3) Both of these will then be open to anyone in the world as a self-study, massive open online course (MOOC), with members of the general public able to register and follow the training course at a time suitable to them and for a duration of their choosing. In making the shift from training professional crisis managers, to a MOOC used by the public, changes to the Pandora+ environment were required, and this included taking on board the behaviours and approaches to training by the general population when engaged with self-study, from lessons learned in the recent delivery of a MOOC run as part of the dCCDFLITE (2015) project ([2]*Bacon et al*, 2015). The research goal of this paper is to define the design principles and building blocks appropriate for an online crisis preparation learning environment, enhanced with the training and educational elements of a MOOC.

The rest of this paper is structured as follows: we first discuss some of the key issues in attitudes, willingness to prepare, and training of the general population for crisis response. We then present the factors to take into account from an educational perspective, based on the research around online education and MOOCs. We continue with an analysis of the design and development of a distributed version of Pandora+ required to train the general population in crisis preparedness. We conclude with a summary of our contributions and an outline of our future work.

POPULATION PREPAREDNESS – ATTITUDES AND BEHAVIOURS

When a crisis occurs and a population is alerted, people go through several stages in their cognitive thought processes, which are reasonably consistent across the population regardless of whether there is an immediate threat or not. The sequence of thought is typically as follows: receive, believe, personalise, respond and confirm (Paton 2006, Mileti & Peek 2000, Perry et al 1982); and these can occur quickly for an immediate threat or over a longer period of time if a crisis situation is unfolding. In terms of personalisation, research has shown that the greater the relevance to oneself, the greater the perception of risk (Dow & Cutter, 1998, 2000).

There are however many factors which influence a person's decision whether or not to prepare for a possible crisis, and their behaviour during a crisis. For example, , men are more likely to tune in to TV and radio, whereas women are more likely to use social networks and call people (Bagrow et al, 2011). Women are also more likely to prepare because they have a higher perception of risk (Fothergill, 1996 cited in Paton, 2006). The manner in which information on a disaster or crisis is presented (Seydlitz et al, 1994) is another factor that affects the public's response. Research also shows that most people have a significant expectation that local authorities and central Government will prepare for, detect and manage disasters, and recovery thereafter, and they look to them for communication and support. Confident people are less likely to prepare for disasters but cost and inconvenience have also been shown to be a factor.

There are however many vulnerable groups at a time of disaster, and it has been shown that the less control a disadvantaged person has, the less likely they are to prepare (Legates & Bidel, 1999). This includes transient populations, such as tourists, who are considered at a disadvantage during disasters (Quarantelli, 1994) and tend to be one of the first to evacuate and least likely to seek help from authorities (Lindell & Perry, 2004). A list of vulnerable groups from the Vulnerable Populations Outreach Model based on English-speaking nations (Klaiman et al, 2010) has been developed. Also, minority groups are often more vulnerable as they exhibit higher levels of scepticism about official communications, and are less likely to evacuate (Perry et al, 1982). Finally, disaster spectators and volunteers who travel to a disaster site for curiosity, adventure, to help, to witness a continuing disaster, etc. can also bring challenges.

As part of the POP-ALERT project a survey was conducted across Europe of peoples' experiences of disasters, their perception of threat and risk, their expectations of authorities and their attitudes to preparation. The survey was answered by 1612 participants and was issued in 6 languages (Filippoupolitis et al, 2015), and two key questions were asked about people's willingness to prepare:

Which statement best represents your preparedness for a disaster?	
I do not intend to prepare	15.80%
I intend to prepare	42.96%
I just started preparing	19.88%
I am prepared	21.36%

Those who did not intend to prepare or intended to prepare were asked a follow up question. They were allowed to tick multiple answers, and the average respondent ticked 1.66 answers:

Why have you not prepared?	
I don't know what I should do	35.94%
I didn't have time	16.80%
It costs too much	6.82%
I don't think it is important	9.03%
I don't think it is possible	11.37%
Emergency services will help me	13.90%
Other	6.13%

Since only 15.80% of the population are unwilling to prepare, we can help the 42.96% of the population that are willing to prepare and the 19.88% who have started to prepare, but are perhaps unsure how to continue.

ONLINE EDUCATION AND MOOCS

The literature on the benefits of training the public and the benefits of training first responders is sparse and suggests that learning may not result in more protective action (Leonard et al, 2008). Lalo (2000) observed that there isn't necessarily a link between people's actual behaviour and what they learned, and of course learning fades as time passes.

There are many websites providing advice on disaster preparation and associated kits for both humans and pets, however from the respondents' answers to our survey questions, it would appear most are not aware of them. There has been at least one attempt to offer disaster preparation in the form of a MOOC, which has run on the Coursera MOOC platform several times, however MOOCs in general tend to have very poor success rates for many reasons ([2]Bacon et al, 2015), so it could be argued that they may not be the best approach, yet they do remain attractive as they have the ability to engage a large audience, and traditional approaches may not be sufficient given the scale of the training required.

From our experience, MOOCs do have their challenges, and the pedagogy is important. The role of a teacher has to change to become more of a facilitator than an instructor given the number of students involved.

Whilst the facilities available on different MOOC platforms differ, they all have a typical common core, for example, a place where learner materials are located, links to reading materials, videos to watch, discussion fora for debates, quizzes etc. However, by comparison, players engaged in Massive Multi-player Online Role Playing Games (MMORPGs), which provide an immersive online gaming environment and are also open to massive numbers, achieve far higher levels of engagement and return. In general, whilst there may be short-lived immersive components within a MOOC, they generally do not offer immersive, engaging experiences. Our approach is to combine the best of both worlds, i.e. to utilise an engaging and immersive, rich multimedia training environment as a MOOC platform.

PANDORA+ DESIGN AND DEVELOPMENT

In this section we first elaborate on the motivation behind the design decisions for the distributed online version of Pandora+. We then analyse the features of the Pandora+ training environment, which enable the delivery of training to the general public in the form of a MOOC.

Motivation Behind Design Decisions

In order to provide mass online disaster preparation, the decision was taken to develop the Pandora+ environment as a distributed, online, self-study, immersive environment that could be run as a MOOC platform. This design approach focuses on an individual's ability to cope with an evolving crisis situation. To achieve this, the capability of running a scenario without the existence of a trainer was added. In the original Pandora framework, a trainer was responsible for both the creation of the scenario and for dynamically customising an evolving training session (e.g. by updating a scenario with additional events during execution). The dynamic real-time interventions of a trainer have been replaced by a scenario that is fixed during execution. More specifically, in the case of the our planned trials we have designed the scenario using a combination of emergency notification events and questions addressed to the participants, requiring responses that can be determined from an online dashboard information system, developed by the POP-ALERT project. Since the scenario is running to a fixed timeline, participants who are unaware and/or unprepared for disaster sitautions will find themselves under pressure of time to determine their responses.

Pandora+ Features

The Pandora+ environment has a wide range of features that enhance and facilitate the delivery of training to the general public in the form of a MOOC:

Stress Management: A key focus of the design of the Pandora+ environment is the management of trainee stress, as research has shown a clear link between stress and cognition (Sales et al. 1996). Stress reduces a person's psychological capacity. It can reduce their ability to undertake protective behaviours including information seeking and processing that information (Vihalemm et al 2012). In short, a person's decision making abilities are affected by their level of stress, which may mean people devote insufficient time to considering alternative solutions, consider them in a disorganised manner, and perhaps make decisions before considering all the potential information. For this reason the Pandora+ environment was designed with a number of controls to support the trainer in managing the stress of each trainee, in order to create as realistic a crisis environment as possible, such as the ability to add new events, and speed up or slow down, the execution of a scenario.

Distributed Web Application: Both the original Pandora and current Pandora+ systems were initially designed to be used only in an environment with a trainer present. They were both developed to run over a local area network with the client installed on the trainee computers and the server installed on the trainer computer. So the design of the scenario for the general public required a number of changes to the Pandora+ training environment, to enable it to be used as a MOOC platform. In order to retain the rich multimedia, immersive nature of the environment, it still required to be focused around a scenario incorporating a wide range of multimedia elements, with a sequence of time-driven events demanding regular decisions from the trainees, no longer controlled by a trainer. Given the evidence from the MOOC experience, that users wish to study when they like, for as long as they wish, the environment had to be redesigned to run as a multi-instance automated trainer programme controlling many hundreds or thousands of user instances at any one time, all running separate instantiations of the scenario for as long as the user wishes, retaining state information if they wish to stop and return. The system also had to be web-based so that the trainee environment can be run in a standard web browser.

MS Office Interface: Additionally, to reduce the requirement to learn an unfamiliar interface in order to use the system, the interface was designed based on Microsoft® Office, being possibly the most familiar interface worldwide. Since it is not possible to predict what devices users would wish to use for the training, a responsive design approach was adopted to enable the interface to be viewed on mobile devices. Figure 1 shows an example screen shot of a scenario executing in Pandora+. Another major change to the design was to parameterise the language used for all the interface and help information and offer language variants of the actual scenario information.

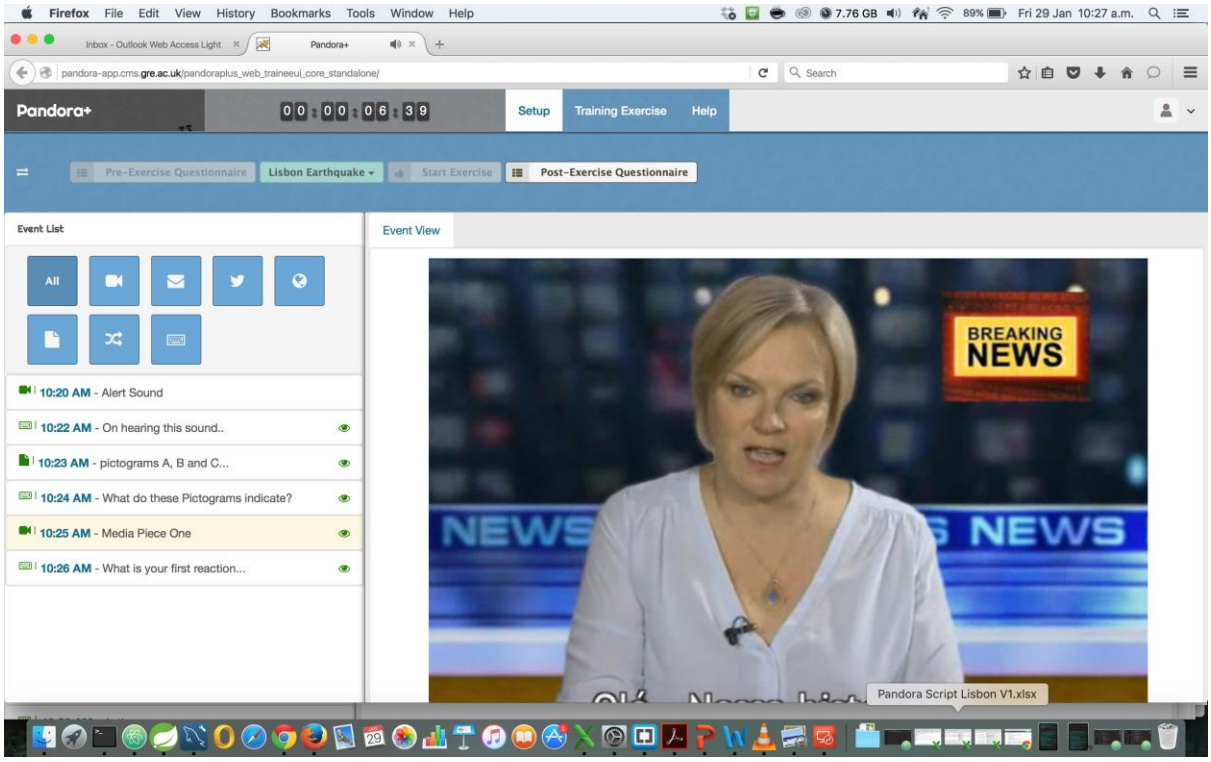

Figure 1. Trainee Interface – modeled on MS® Office look and feel, playing media news piece

Adaptable Scenario Duration: Taking on board the lessons learned from the MOOC, the length of the training scenario is significant. Many more people will find time for five minutes of training than thirty minutes of training, so bite-sized chunks of learning are important, divided up by topics of key interest to them so people can choose the order in which they engage. For example, for our planned trials we have included questions such as "List the items you would expect to find in your emergency kit" and "List some of the key information in your family emergency plan" which can be answered within a five minute time window. Therefore, in the general distributed application, participants can break up their interaction with the scenario into shorter segments if they wish to do so.

Data Logging and Recording: One of the key features of the Pandora^{+} system is the recording feature, which logs all communication and decisions made by a group of trainees for use in debriefing sessions with the trainer after a training event, either as a group or an individual. As there is no trainer in this distributed MOOC version, because people can study the material at any time they wish, the system has been developed to provide feedback on their performance, by integrating feedback into the scenario development. This could either take the form of providing example solutions once the participant has input their own solution (lending itself to automated marking if required), or, as in the field trials in Lisbon and Corsica, the provision of the online POP-ALERT dashboard that provides the participants with information and advice regarding the crisis event in question. The recording tool will still gather data on decisions taken by the public and provide rich information about how people may perform in the event of a crisis. This data will be gathered and analysed on an on-going basis to enhance future training materials. Combined with the demographic data captured when users register to use the system, this will also provide a rich source of data that can be analysed not only to improve the quality of the training materials, but also to determine user appetite for training, preferences for type and nature of information, support for preparation, levels of knowledge and preparation and if MOOCs have more potential to reach vulnerable groups. Potentially, this could be a rich source of data for future crisis preparation initiatives, and may offer a vehicle for trials of such initiatives.

CONCLUSION AND FUTURE WORK

Research has shown that the vast majority of people are willing to prepare for a crisis but do not know how. In other words traditional forms of education are not working. The adaptations to the Pandora^{+} environment described here have demonstrated the potential to provide immersive online self-study training, utilising lessons and pedagogies from MOOCs such as the use of a bite-size delivery model, to reflect user preference for quick, short and rewarding engagement rather than completion.

The trials in the Spring of 2016 will provide valuable feedback and evaluation of this approach to support awareness and preparation for crisis response by the general public. The authors believe the enhancements to the Pandora^{+} system have demonstrated the capacity to provide a distributed, online, immersive, multimedia, engaging environment designed for mass education of the public to support them in developing their crisis preparation and response skills. Future enhancements to Pandora^{+} include the adaptation of the trainer functionality to provide synchronous community training, which will support discussion and debate between trainees making decisions about how to behave in the event of a crisis. This includes the potential to engage with emergency professionals and interact with them directly during a simulated crisis. More training scenarios will be released and further development of the behavioural framework to automate the stress management of a trainee, both with the support of a trainer and in the absence of a trainer.

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