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Risk Assessment Education: Utilising Interactive Video for Teaching Health and Safety

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EXECUTIVE SUMMARY

The level of accidents and ill health within the construction industry still remains at an unacceptable level, costing up to £6.5 billion per annum, with around 70 workers being killed annually in the UK alone (HSE, 2006). Significant gaps in the training of senior management (technical and leadership skills), project managers (project integration and performance monitoring), site supervisors (poor training recognised in all areas) and designers (a wider practical appreciation needed of the industry in general) have been identified, impacting on health and safety (Egan, 1998). Current training regimes also have to cope with increasing numbers of ethnic and migrant workers entering the industry at all levels. It is now considered that health and safety in education should be presented 'as an intellectual challenge illustrated by practical example' (HSE, 2001; HSE, 2004), following on from the UK's Governments target set out in the 'Revitalising Health and Safety' strategy (DETR, 2000). A key question concerning the current educational delivery mechanisms is whether the basic recall of lecture notes in an exam environment (e.g. for NEBOSH or undergraduate degrees), or the recognition of answers in a multiple choice setting (CSCS test) is preparing individuals to execute, apply and prioritize matters of health and safety in the field (Biggs, 2003 p.43).

With the aid of funding from the University of Southampton's Learning and Teaching Enhancement Unit (LATEU), a prototype interactive learning environment for risk assessment health and safety training has been developed. A case study application has been created to test the prototype involving the set-up of a traffic engineering experiment, designed to assess the risk assessment abilities of second year civil engineering undergraduates. The prototype has been realised through a joint collaboration between the Schools of Civil Engineering and the Environment, Electronics and Computer Science and Psychology. The end goal of the research is to produce a tested framework through which interactive videos can be developed for educating the diverse work force found in the construction sector.

INNOVATION

The concept is novel as it considers the complex and multivariate problem of applying gaming concepts to the delivery of health and safety educational material. A game based on real construction site footage, where the learner (professionals to unskilled staff) can experience failure

and its consequences from the comfort of their own homes, the classroom or wherever they want to learn has many potential applications (risk assessment exercises, managerial decision making under pressure (prioritising actions as a site manager), accident investigation and procedure following). Video streaming has been extensively used to support and facilitate learning, (Barford & Weston, 1997; Green et al., 2003; Shepherd, 2003; Bates 1985 (in Shepherd, 2003)) but one of its major drawbacks is the inability of the learner to fully interact with the medium and the lack of user control (Laurillard, 2002). This research has shown that interactive video is especially suitable for engaging the learner by providing him/her with the essential elements of 'control' and 'challenge'. Through the traffic engineering case study, we have shown that it is possible to construct the correct cognitive representations that allow knowledge to easily transfer and underpin the principals taught in lectures. Teaching perception and evaluation of risk to any learner group is especially challenging, particularly in dynamic environments. Being able to better engage the learner through the use of visual inputs and not requiring a heavy dependency on language inherent in other learning technologies, interactive video has the power to overcome cross cultural and language barriers as a learning mechanism.

Despite these potential benefits, the very nature of an interactive learning environment implies an increased cognitive load on the learner due to the number of activities required and decisions needed (Schwan and Reimpp, 2004). Although the educational value of instructional video and video streaming is widely documented, the associated impacts of interactive video on the effectiveness of learning are largely unexplored (Zhang et al., 2006) and this is currently being explored in this project.

TECHNICAL SPECIFICATIONS

The aim of this project was to produce a video for undergraduate civil engineering students showing the risks associated with filming traffic on a busy urban road. The video was filmed from the perspective of how not to undertake the fieldwork and was based on a well practiced technique that had been employed for registration plate capture surveys over a number of years. The experiment set-up was filmed in one continuous take lasting just over two minutes.

Upon completion of filming, the subsequent video was imported into the Adobe Flash authoring environment. The video was designed to operate in three distinct stages:

1. The video is watched and hazards are identified by clicking on locations in the video and using a combination of free text boxes and statement declarations. Once finished this information is submitted to a database along with the student's name.
2. Each hazard which is apparent in the video is then shown to the student with text and images to explain why it is a hazard and how to avoid this situation arising.
3. The video is viewed again as in 1) however this time each hazard is identified for the student as the video plays.

The video is played by the student through a web browser and can be re-wound at any point until the end is reached. The student identifies a hazard by clicking at the appropriate position on the video. By doing this, it is possible to know at what exact time the student clicked the left mouse button and also the x and y position of the mouse pointer. Once clicked, the video is paused and a box appears asking the student to provide more information and also select an appropriate statement which classifies the severity of the hazard identified (Figure 1). This information is then stored within the system ready to be sent to the database. The student can revisit all incidents that have been selected to make amendments if needed.

Figure 1. interactive video screen shot – clicking on a hazard

After the video has been viewed once in its entirety, a basic calculation (unknown to the student) is carried out comparing the number of hazards identified against the actual number present. If there is a disparity the system suggests that the student re-examine the video and either look again for more hazards or look again at the hazards already identified. Upon reaching the end of the video a second time the interactive element of the video finishes and all hazard information along with the student's name is sent through the web browser via the HTTP POST protocol to a MySQL database.

Once the interactive element of the video has been completed, the official hazards are then shown. A still image of each hazard is chronologically displayed accompanied by text explaining the hazard along with a still image illustrating the solution (Figure 2). The student can then navigate between hazards by using the 'next' and 'previous' buttons.

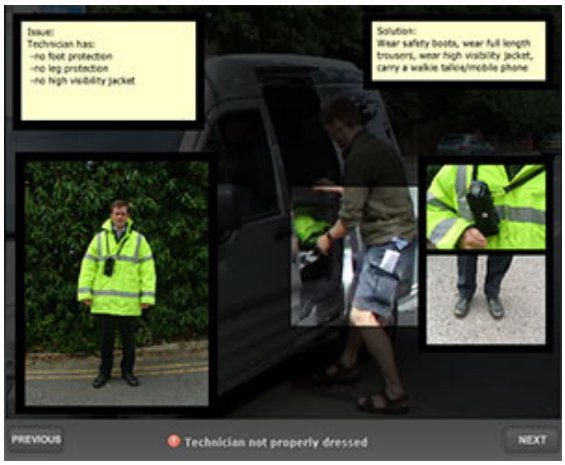

Figure 2. still image illustrating solution to hazard with accompanying text

After viewing all the hazards, the system then asks the student to watch the video one more time from start to finish with each hazard identified as the video is played. In order to make this possible, cue points were established when encoding the video to allow the system to jump to the appropriate point where the hazard was demonstrated. At this stage, this is the end of the interactive video simulation for the student. The course instructor can now view all submitted data using the administration panel. By clicking on a hazard identified by a student, the video will jump to the appropriate time and show where the student clicked (Figure 3).

Figure 3. clicking on student submitted data in the administration panel

PEDAGOGICAL ASPECTS

With the recent advances in multimedia technologies, interactive videos can be synchronised with a wide range of media formats (e.g. PowerPoint slides, graphics, simulations) which increase the intensity of visual and verbal cues. The use of such multiple formats in addition to the multi-sensory learning environment created by video (Syed, 2001 in Zhang et al., 2006) has the capacity to i) increase an individuals ability to transfer information from the short-term to long-term memory, whilst creating a more effective learning experience (McAteer & Shaw, 1995 in Cairncross & Mannion, 2007) and ii) enable learners to engage with their strongest learning modality (Abell, 2006) whilst appealing to different learning styles e.g active, reflective and sensing (Baldwin & Sabry, 2003). Interactive learning environments can therefore generate an effective instruction and flexible learning experience (Harper & Hedberg, 1997) which is fundamental for knowledge acquisition (Baldwin & Sabry, 2003).

The interactive video concept developed here eliminates the linearity associated with traditional video through the use of on screen controls (e.g fast forward/rewind, pause video) which provide the learner with complete control of their learning experience and the speed with which they learn (Zhang et al., 2006). The interaction between the player and the video enhances engagement (Agius et al., 1999, in Zhang et al., 2006) and is further enhanced through the provision of feedback on performance as part of the learning experience (Yahaya & Sharifuddin, 2000). The use of interactive

video to enable learning through the process of experiencing failure (Schank, 1997) has great potential for fostering 'deeper learning' (Bloom, 1956) and is applied here. Knowledge acquisition and particularly, knowledge retention, through trying and failing at a task can be a very powerful learning mechanism (Van der Velden, 1999) and can help develop context dependent learning (Godden & Baddeley, 1975) enabling more effective application of principles learned in the workplace and accelerating the process of skill acquisition (Schwan and Reimpp, 2004).

- Examples of use

The case study interactive video has been piloted and a first stage evaluation completed using a group of 75 second year undergraduate civil engineering students.

- Actual state of development and use

This initial evaluation is aimed at identifying operational issues in using the video and gaining initial feedback on its usability and scope for aiding a current lecture series on risk assessment in construction management. The case study video was designed to complement a current lecture on risk assessment which used the traffic engineering experiment to engage students and test their lateral thinking related to risk identification and mitigation. In the application developed the assessment tests and questions are specific to the application. The aim is in future generation is to use an interoperability standard such as QTIv2 for the tests and questions. This will further allow the sharing and reuse of the web based system, as it can be 'plugged' into any compliant Virtual learning Environment.

- Further developments (if needed)

The LATEU funding also allowed the development of a second interactive video (started after the award application) in the field of laser safety. This included spoken dialogue and incorporated multiple choice questions sets operating with hidden 'hot-spots' embedded into the footage. This video has developed a scoring mechanism and automated feedback process for players. The laser safety interactive video can be accessed at: http://users.ecs.soton.ac.uk/jtp/projects/laser.

Using the features from the two videos, follow-up funding is being sourced to allow for a suite of interactive videos to be developed on Construction Site Health and Safety in association with Laing O'Rourke. The videos will cover the key risk areas of working at height and transport access and egress. They would be filmed using the facilities at the National Construction College, Norfolk.

EVIDENCE OF USEFULNESS AND BENEFITS OF THE INNOVATION

Ninety five percent of the students stated that the lecture and video combined were an effective combination of learning tools for new students. Seventy five percent stated that the interactive video had enhanced their learning experience with 60% feeling that more health and safety material on the module should be taught with the aid of this technique.

Student Comments:

Good way to assess how much I had learnt about risk assessment during the lecture and putting it into practise in a safe manner.

Could not visualise some of the risks until seen in the video

Added interest, was a different way of learning/being tested

I think the video helped to further my understanding as it helped me to see how many risks there were. I do not feel it would have been as affective without the base understanding from the

lecture.

I liked the fact that it was interactive and held your attention. I also liked how it goes through all the hazards at the end so you can see what you've missed.

The interactive video was very easy to use and did not take up much time. It also allowed the user to go back and see clips again to ensure I was happy with the answers I had given. It also made a subject, which I think could become boring a lot more interesting.

It put into context what I had learnt from the lectures. Also demonstrated the many different risks associated with something as simple as erecting a camera

Made it easier to spot hazards, visual aspects make learning easier. The video format would be especially useful for more complex risk assessments than this one, and is a good way of learning about this subject.

I feel the video was very well made. It reminded me of the hazard perception test for driving! It showed what was learnt in the lecture in a real life situation which is very memorable. The video shows the lecture material in real life situations which can be remembered easily as a case study.

On the whole, the interactive video was very useful because it makes you take part in the learning process and expresses the hazards well after the test had been taken.

Liked the 'answers' section afterwards, useful to learn to spot more obscure hazards. Liked the realistic situation and location, liked the interactivity

The showing of the solutions was very good allowing time for the hazard to be accepted and showing when it occurred.

Good way to assess how much had learnt about risk assessment dring the lectures and putting it into practise in a safe manner.

It demonstrated what had been discussed in lectures in the actual real life situation, clarifying any unclear points. The use of interactive video should not be used as a replacement for lectures but should aid them.

The project so far has helped to qualify the ways in which interactive and graphic-rich videos could be used to make the learning experience more 'inclusive' and exciting. Having the students completed risk assessments (Figure 3) will allow a much more detailed assessment of the risks identified, the perceived seriousness of those risks and their likely probability of occurring. With a larger sample of students (planned), differences in attitudes towards risk between different cultural groups will be possible.

- Availability for others

The interactive video is available to others to use with the permission of the Learning and Teaching Enhancement Unit at the University of Southampton

- Means to test the project from a distance (for the jury).

The video can be viewed at:
http://users.ecs.soton.ac.uk/jtp/projects/interactiveVideo/

The laser safety video is available at:
http://users.ecs.soton.ac.uk/jtp/projects/laser

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