THE DELIVERY OF HEALTH AND SAFETY TRAINING APPLYING MULTIPLE INTELLIGENCES USING VIRTUAL CLASSES

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The construction industry is a challenging mix of traditional hazards, on standard repetitive construction projects coupled with complex one off landmark projects. There is a compelling moral and business case for training and learning resources addressing health and safety training in the construction industry. A network of educational institutions within Europe have undertaken an initiative that addresses the delivery of health and safety training, using e-learning, on a pan European basis in the construction industry sector. An established training need module, based on an analysis of UK, Irish and Turkish health and safety statistics has been identified. The research work proposes to use the theory of multiple intelligences (MI) which postulates that there are several independent ability areas which individuals possess. The pilot material will be delivered using falls from heights as the subject matter. The development and refinement of the resources will take an action research methodology approach. The expected impact of this initiative is to develop a new innovative framework and educational resource using multiple intelligences that is directly focused on health and safety in the construction industry.

Keywords: e-learning, health, multiple intelligences, safety, virtual classes. .

INTRODUCTION

The construction sector is the world's largest industrial employer with an estimated 111 million people employed accounting for as much as 10% of GNP (Wall *et al.*, 2007). Construction remains a very labour intensive industry involving hazardous work activities that present an unusually high risk of injury and ill health. Even with technological advances and modern sophisticated plant and machinery, there are still many hazardous tasks to be carried out. More workers are killed injured or suffer ill health in construction than in any other sector (Wall *et al.*, 2007).

One of the key initiatives that can make a positive impact on improved health and safety statistics is education and training, both in the classroom and on the job training. Taylor *et al.* (2006) identified this when investigating the "proof of concept" stage for an e-learning package to teach engineering undergraduates. Their research found from discussions with several major industrial companies the overall response

Wall, J, Carney, M, McNamee, F, Madden, D, Hurst, A, Vrasidas, C, Chanquoy, L, Baccino, T, Acar, E, Önwy-Yazici, E and Jordan, A (2007) The delivery of health and safety training applying multiple intelligences using virtual classes. *In:* Boyd, D (Ed) *Procs 23rd Annual ARCOM Conference,* 3-5 September 2007, Belfast, UK, Association of Researchers in Construction Management, 315-323.

from industry was positive. A network of organization have secured funding through the Socrates Minerva Action, to address this challenge and create training and learning resources using online and distance learning methodologies focused on the issue of health and safety in the construction industry.

DESCRIPTION OF PROJECT

The partners involved include, Nottingham Trent University in the UK, Istanbul Technical University in Turkey, Universite de Nice Sophia-Antipolis in France, Centre for the Advancement of Research and Development in Educational Technology in Cyprus, Multimedia Instructional Design, Blended Learning Design and Waterford Institute of Technology in Ireland. The Irish, Turkish and UK partners provide the specific construction expertise in the subject domain as part of the project. The Cypriot and French partners are charged with providing the psychological and technological delivery of virtual classes' expertise as part of the partners. The ultimate target group for the delivery of the learning are construction personnel, such as foremen, as part of their on-the-job training, charged as part of work with responsibility for health and safety. Initially the target groups will be in the United Kingdom, Ireland and Turkey.

The overall aim of this research is to create a multiple intelligence instructional design framework for virtual classes. The specific objectives that the network of partners is attempting to meet include:

- Identify multiple intelligence instructional principles for the design of virtual classes;
- Design a series of virtual classes so that class design skills using multiple intelligence tenets are acquired by all partners;
- Enable each partner to design, deliver, record, edit and archive its own virtual class, for an audience comprising all other partners and their chosen pilot student populations;
- Use and develop an on-learning resource dedicated to improving the health and safety record of the construction industry;
- Disseminate the results of the project to all interested EU parties.

As most countries record fatalities in the construction industry, it is reasonable to assume that these give a true picture. However, when it comes to non-fatal incidents it is more difficult to give an exact figure as there may be significant under-reporting of incidents of this type. There are a number of factors that may contribute to this. Typically the industry consists of a high number of either self-employed or very small enterprises (fewer than 10 people). This may result in many people who experience non fatal health and safety incidents on construction sites not reporting them as it may affect their ongoing income. This presents a challenge facing the partners in undertaking this work is developing an understanding of the common issues and challenges facing countries throughout Europe in construction health and safety. Countries classify all types of records and statistics in different formats, making it more challenging to present a consistent analysis of figures.

HEALTH AND SAFETY IN THE UK CONSTRUCTION INDUSTRY

A review of Health and Safety Executive (HSE) reports in the UK highlighted, in 2005, that almost 90% of construction companies employ ten or fewer workers with a further 70,000 single employee companies. In the UK there were 59 fatal injuries to workers in construction in 2005. Of these 59 fatalities, 42 were employees and 17 were self-employed. When one looks below these headline figures, 24 deaths (41%) were due to falls from a height. Falls from heights mainly involve roofs, ladders, scaffolds and raised platforms. The other major causes of fatalities in UK construction are being struck by a moving vehicle and struck by a moving or falling object.

The HSE in the UK, when analysing accidents over a five year period between 1996/97 and 2001/01 found that the most common types of accidents could be accounted by: (i) fall from heights at 37%, (ii) slips, trips or falls on the same level 21% and (iii) struck by a moving or falling object 18% (Source: Health and Safety Executive Reports).

Figure 1 highlights the breakdown of fatalities in construction over the period from 1999 to 2006. Falls from heights account for approximately half of all fatalities as highlighted in Figure 2. This is fairly typical across all countries (Construction Intelligence Report from Health and Safety Executive UK).

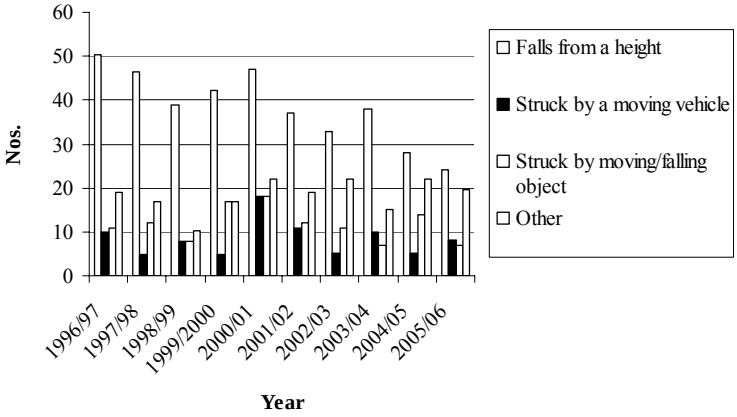

Figure 1: Breakdown of Construction Fatalities UK
Source: Complied from various Health and Safety Executive Reports available at www.hse.gov.uk

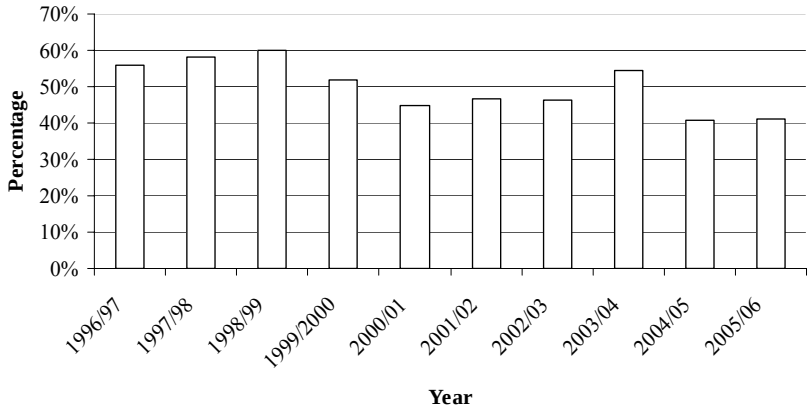

Figure 2: The significance of fatalities due to falls from heights.
Source: Complied from various Health and Safety Executive Reports available at www.hse.gov.uk

CONSTRUCTION HEALTH AND SAFETY IN IRELAND

Currently in Ireland over 270,000 are employed in construction representing over 20% of the working population. Table 1 presents the total number employed each year since 2000 and the corresponding fatalities for each of the years.

Table 1: Construction fatalities in Ireland

Year	Fatalities	Approximate number employed
2000	17	166,300
2001	22	226,800
2002	21	190,900
2003	20	250,000
2004	16	242,400
2005	23	277,100
2006	16	280,000

Source: Health and Safety Authority Reports available at www.hsa.ie

Figure 3 highlights the breakdown of fatalities and the number of fatalities due to falls from heights since 2000, while Figure 4 illustrates the significance of falls of heights in the overall context of construction fatalities.

CONSTRUCTION HEALTH AND SAFETY IN TURKEY

Access to reliable statistical data associated with occupational health and safety is a major problem in Turkey. Official statistics of the Social Insurance Institution (SII) General Directory only give number of total injuries, fatalities or permanent incapacity cases by industries. However, a recently completed PhD. thesis by Gürcanli (2005) in Istanbul Technical University investigated approximately 40,000 accident records in all industries including construction. Analysis of the SII General Directory Archives revealed that 4,347 of all accidents occurred on construction sites, in various regions of Turkey between 1969 and 1999. In addition to these statistics, Gürcanli (2005) examined 892 court expert reports which were submitted to criminal and labour courts.

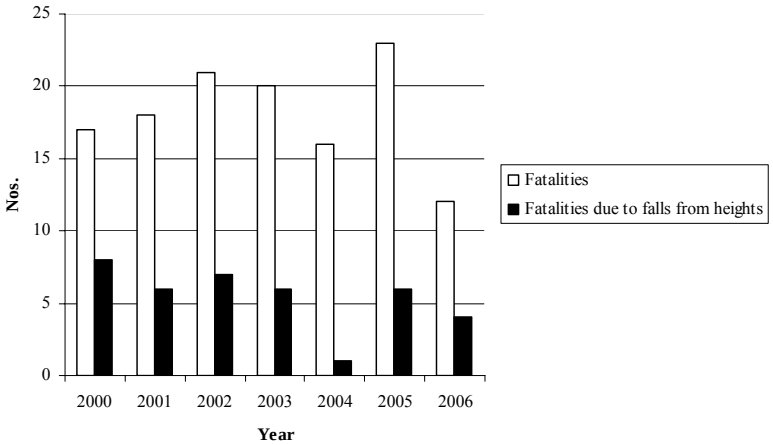

Figure 3: Total fatalities and fatalities due to falls from heights.
Source: Compiled from various Health and Safety Authority Reports available at www.hsa.ie

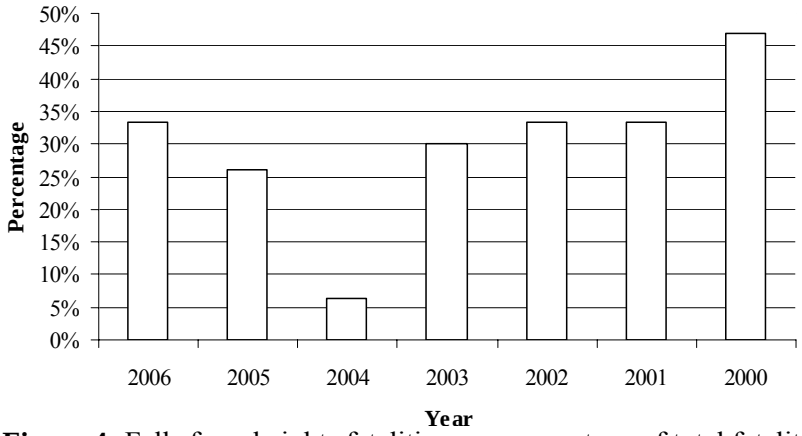

Figure 4: Falls from heights fatalities as a percentage of total fatalities
Source: Compiled from various Health and Safety Authority Reports available at www.hsa.ie

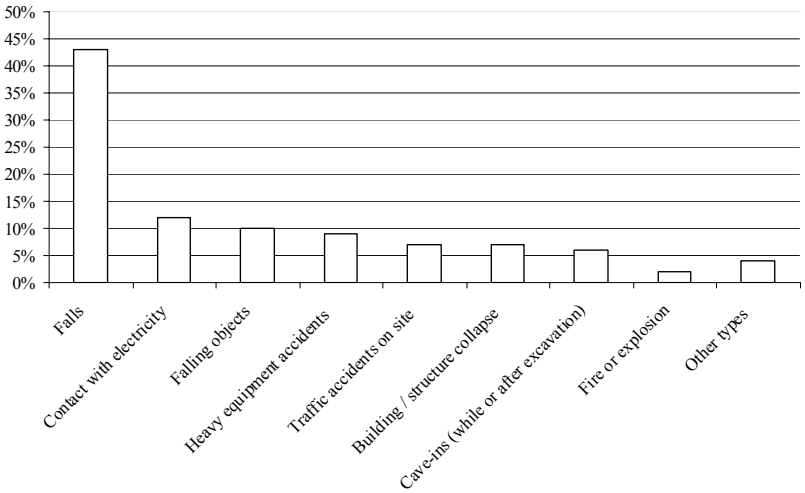

Figure 5: Falls from heights fatalities as a percentage of total fatalities
Source: Gurcanli (2005)

Figure 5, summarized from Gürcanli's analysis, serves to highlight that falls from heights represents over 40% of all fatalities on construction sites in Turkey in 2005.

An overall analysis of fatalities in the UK, Ireland and Turkey presents a compelling case for the creation of resources addressing the area of falls from heights. The partners have agreed that as a pilot programme for the virtual classes that learning material focused on improved training and learning in falls from heights merits consideration as the pilot module for the virtual class using a multiple intelligences framework.

VIRTUAL CLASSES

With the rapid growth of computer networks and advances in telecommunications, distance education has become a major setting for delivering instruction remotely. For educational institutions and for workplace based learning online environments are rapidly expanding as a channel for the delivery of learning. A review of the literature helps to identify a number of characteristics of effective virtual learning environments, which can be classified into 2 overall categories, technology design and specifications and pedagogical considerations (Vrasidas, 2000, and Vrasidas and Zembylas, 2003). These characteristics can be classified in 2 main categories: technology design and specifications and pedagogical considerations (instructional design, assessment, etc.).

To create a virtual class, one must plan for the following tasks, (i) curriculum development, (ii) content development, (iii) articulation and credentialing, (iv) learning delivery, (v) advising, (vi) hardware choice and (vii) assessment (Harper *et al.*, 2004). Virtual classroom technology is designed to facilitate synchronous collaboration by allowing a live classroom experience to be conducted over the Internet. Typically it includes functionality such as; (i) voice over IP (VoIP), (ii) video conferencing, (iii) shared whiteboards, application screen sharing and live feedback, (iii) archiving of classes as learning objects and (iv) interconnectivity with the learning management system. The popularity of the virtual class medium has grown enormously in recent years because of its potential in terms of reach, scale and engagement value. Also, because a class can be archived, it can be redelivered at any time and so it becomes a reusable learning object.

MULTIPLE INTELLIGENCES

Educational theorists have argued that in an effective educational setting, instructors must appeal to a wide variety of intelligences, for example some are visual learners while others prefer more tactile experiences and others need to hear information presented orally (Staley, 2004). This project consortium has selected Howard Gardner's work on Multiple Intelligences as the basis of attempting to understand the complexity of learning. Gardner (1983) identifies eight intelligences that individuals' engage while learning. These he classified as: logical, linguistic, interpersonal, intrapersonal, musical, visual, bodily and natural. Multiple intelligence theory has generated considerable debate, gained considerable credence in academia and it has being tested extensively. However, a feature of the multiple intelligence philosophy and research is that it is predominantly based on the traditional classroom. The innovative aspect of this is to deploy virtual classes addressing multiple intelligence into an e-learning environment through deploying learning resources and evaluating the learning experience.

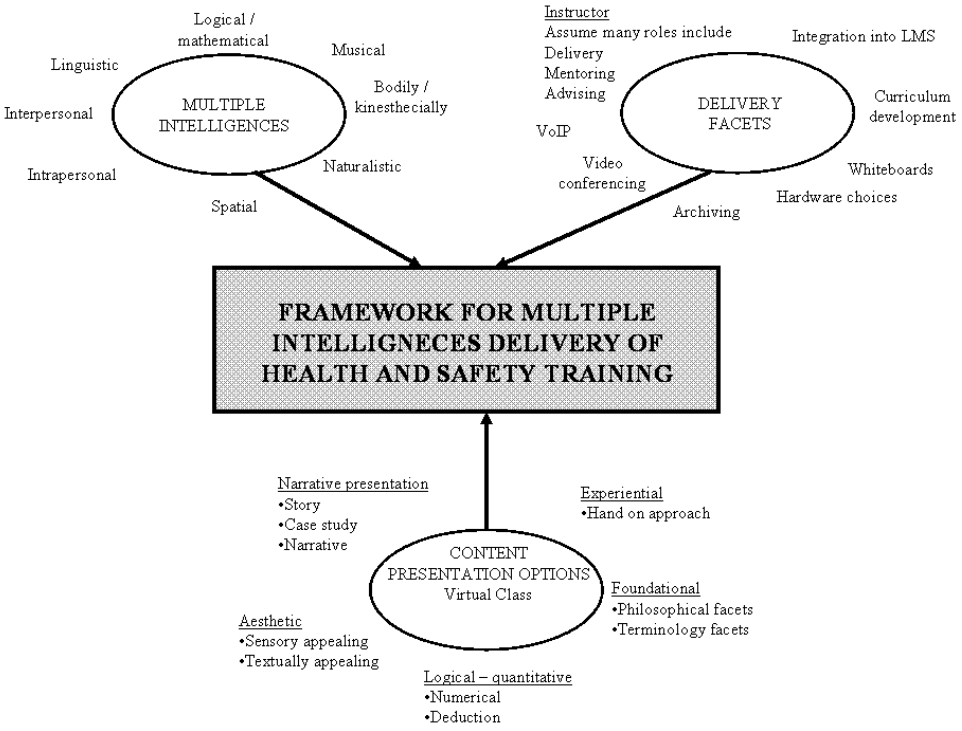

Figure 6: Framework for Multiple Intelligences in Health and Safety

Source: Wall *et al.* (2007)

One of the key design criteria in the presentation of content is to ensure that the content in presented in more than one way, in line with Gardner's five multiple entry points: the narrational (story, case study, narrative), logical-quantitative (numerical and deduction considerations); foundational (philosophical and terminological facets of the concept); aesthetic (the sensory or surface features appealing to the artistic); and the experiential ('hands-on' or active) approach. This is illustrated in Figure 6.

PROGRESS TO DATE

It is anticipated that the development of the virtual classes component will consist of a series of archived virtual class samples with durations of between one and ninety minutes that have the following components:

- audio and visual instruction on health and safety;
- incorporation of the Gardner '*multiple entry point*' principle in content presentation;
- multiple rehearsal opportunities to enable the exercise of the individual's multiple intelligences;
- collaborative, engaging and interactive features including public and private chats, surveys, polls, audio contributions and shared use of presentation tools;
- specification and production of pre-class and post-class learner activities breakout and plenary session components;
- a range of valid and reliable assessments including both traditional testing and portfolio-based submissions.

A dedicated website www.virtualclassescentre.com is being developed for the project. This resource will act as a repository for content developed and the virtual classes and facilitate dissemination of the project. The anticipated impact is to develop a new innovative framework and educational resource using multiple intelligences that is directly focused on health and safety in the construction industry. By applying the multiple intelligence philosophy to the design of virtual classes, the foundation will be laid for the rigorous application of such standards to the medium. A pilot module will be developed and deployed to measure the effectiveness of the framework and refinement will take place based on the evaluation.

PILOT DEPLOYMENT OF VIRTUAL CLASSES

For a pilot module the following learning outcomes have been identified following:

- Describe the hazards of working at heights
- Discuss the consequences of falls from heights

With respect to the various potential entry points that can be used to engage participants based on the multiple intelligences profile of the audience and the following instructional media and methodologies will be used:

- Video;
- Images/photos;

- Statistics;
- Narration;
- Problem solving.

It is anticipated that the virtual class will be structured and sequenced as outlined in Table 2.

Table 2: Virtual Class Event and Sequence of Activities

Event	Sequence of activities
Gain attention/Generate Impact	Use of a video and related instructional activity
Statistics	Statistics can be illustrated so as to exaggerate the point. Participants can then be requested to perform a related exercise
List hazards and a link to an illustration / definition	Here the most appropriate approach is to use a graphic could be designed that showed all the hazards
Emotional and financial	One possibility is to have an interview with a bereaved widow of a person who fell from heights or an interview with a person who has suffered a fall from height. Participants can the be requested to engage in a related exercise

Having deployed the pilot modules, a detailed evaluation of the effectiveness of the pilot programme will be undertaken.

EVALUATION METHODOLOGY

A case study methodology will be applied as part of an empirical approach to evaluating and deploying the resources targeted at health and safety in construction. Case studies research methodologies have few generalisable requirements other than access to the level of data required for the study. As a research strategy the case study approach is used in many situations is to contribute to knowledge of individual, group, organizational, social, political and related phenomena (Yin, 2003). Consistency of depth of access is important to get a coherent picture.

Action research is more that traditional interpretative research in the sense that the researcher is directly involved in the research setting and the experience itself (Nunes and McPherson, 2002). Action research involves learning in and through action and reflection and it is often conducted in educational contexts (McNiff and Whitehead, 2002). Figure 7 represents the typical sequence in action research methodology.

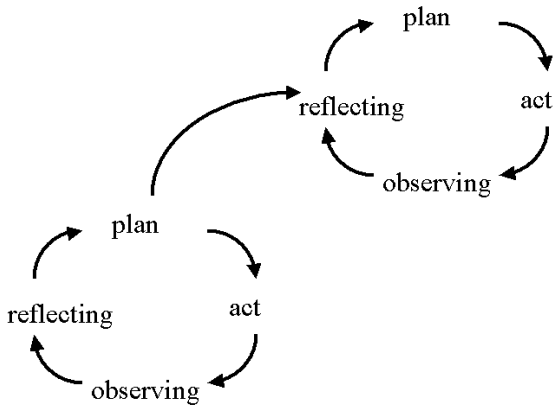

Figure 7: Sequences of Action-Reflection Cycles
Source: Adapted from McNiff and Whitehead (2002)

CONCLUSION

There is a compelling moral and business case for improved health and safety performance in the construction industry. Embracing multiple intelligences and virtual classes as part of the delivery of health and safety training represents a new and challenging initiative. However, it is important to recognize that barriers that may need to be overcome during the deployment of the developed resources are, (i) engaging busy professional with the resources through virtual classes, (ii) that the participants have access to the appropriate ICT infrastructure and (iii) the instructors recognize that they must change their role and assume new responsibilities in the development. The principal beneficiaries from this research will be construction personnel with direct line responsibility for health and safety on construction projects, staff from the institutions participating in the project, teaching staff at higher level institutes outside of participation institutions and researchers in the construction field. The anticipated outputs from the project will include a dedicated server hosting a central website which will secure the material developed and a series of archived virtual class samples.

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