CHALLENGES TO DELIVERING SAFETY TRAINING THROUGH VIRTUAL CLASSES

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In the 2006 construction and housing in Ireland report from the central statistics office revealed that 280,000 people worked in the construction sector. This represents 13% of total employment and is the highest in the European Union. The same report identifies the construction sector as containing the highest rate of fatalities accounting for one third of all work place related deaths. As a result, it is imperative to address health and safety issues in the construction sector. The research looks at providing innovative health and safety training through virtual classes that apply the principles of multiple intelligence (MI). It is proposed that two phases of virtual classes are developed, focusing on the risk of falls from height in the construction sector. These phases will be deployed using an action research approach to further refine and develop each phase. The use of a virtual classroom environment and the application of MI theory represent unique opportunities and challenges. Based on a literature review of current best practice in virtual classes, a survey has been developed to focus on understanding and measuring the user experience, and relating this to student usage of the system as a whole. It is anticipated that the framework developed for these virtual classes as well as the research findings will be hosted on a dedicated website. The website will act as a repository for developed content and virtual classes, as well as facilitating dissemination of the project outcomes. The outcome of the research is the development of an educational resource using MI theory that is directly focused on health and safety in the construction industry.

Keywords: action research, health and safety, multiple intelligence, virtual class.

THE CONSTRUCTION INDUSTRY

Given the rate of economic growth in Ireland in the last ten years there are significant challenges to the construction industry (Graham, 2005). Projects are becoming complex and clients are looking for increased performance in terms of project time frames and cost control. When the requirements of building regulations and health and safety legislation are added to this already complex and fragmentised industry it

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becomes clear new approaches need to look at to meet these challenges (Bennett, 2006; Fadier, 2006).

In order to improve health and safety in the construction industry it is important to have an understanding of the industry's culture. Suraji *et al.*(2006)specifically describes that the culture of the industry as a very male, "macho", and authoritarian one. The industry abounds with conflicts of interests due to different views and objectives among the parties involved (Suraji, 2006).One of the key initiatives that can make a positive impact on health and safety statistics is education and training, both in the classroom and on the job training. It is clear that the industry is in need of not only increased training, but relevant and specific training that reaches to all those involved in the construction process, from the front line operatives to the height level strategic decision makers (Fadier, 2006).

PROJECT DESCRIPTION

The project is made up of educational institutes and training companies from Ireland, Turkey, United Kingdom, Cyprus and France that have secured funding from the Socrates-Minerva Action Program. The funding was secured to evaluate MI in an e-learning environment through deploying learning recourses and evaluating the learning experience. The Irish, Turkish and UK partners are from construction related disciplines and have the resources to test the virtual classes developed by the project and carry out the evaluation process.

HEALTH AND SAFETY IN THE CONSTRUCTION INDUSTRY

Construction remains a labour intensive industry which involves hazardous activities that present an unusual high risk of injury and ill health. Even with technological advances and modern plant and machinery there are still many potentially hazardous activities which need to be carried out on construction projects (Rowlinson, 2004). The UK's Health and Safety Commission (HSC) revels that the incidence of fatal accidents in construction in 1996/1997 data were eight times the average of all industries. The tight constraints of time frames and cost control which are an increasing part of the modern construction industry can potentially pose a threat to health and safety practice (Brabazon, 2000). However innovative thinking in the construction industry would say that construction companies who can control the risk posed by health and safety hazards are in a better position to control risks in all areas of their business (Harris, 2006 ; Suraji, 2006). Making health and safety the top priority makes sense from a legislative and moral stand point as well as making good business sense (Brabazon, 2000). 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 2 highlights the breakdown of fatalities and the number of fatalities due to falls from heights since 2000, while figure 3 illustrates the significance of falls of heights in the overall context of construction fatalities.

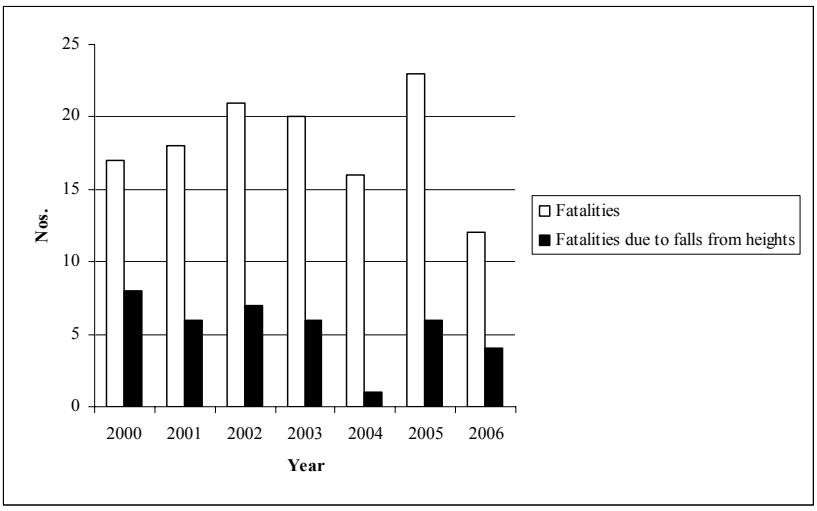

Figure 2: Total fatalities and fatalities due to falls from heights.
Source: Compiled from various Health and Safety Authority Reports available at www.hsa.ie

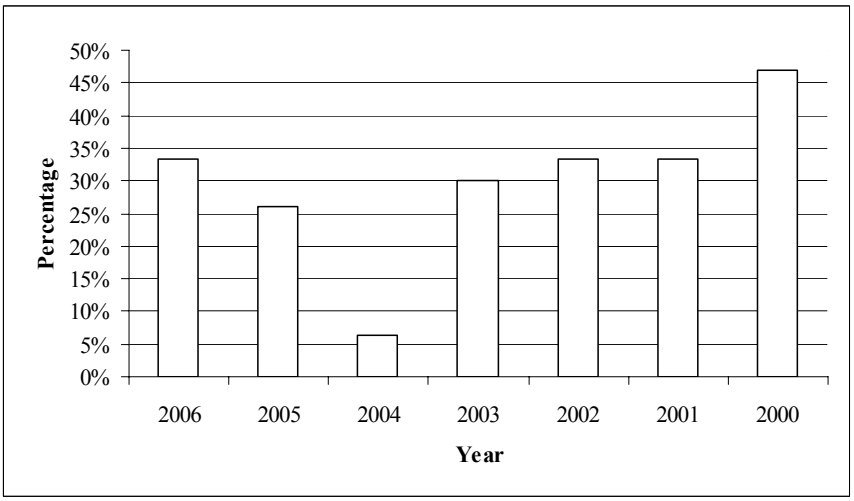

Figure 3: Falls from heights fatalities as a percentage of total fatalities
Source: Compiled from various Health and Safety Authority Reports available at www.hsa.ie

One of the biggest challenges in attempting to increase health and safety training under its current model is that it just becomes an increasing operational cost and concern for those who work on the front line production process such as building contractors (Suraji, 2006). In order to see a real change in the health and safety record, health and safety must be a primary concern all the way to the top of the construction industry and include stakeholders such as clients and end users. A key expression of that primary concern would be a comprehensive health and safety training program that would involve all the parties in the construction process. The program would be tailored to meet the roles and responsibilities of all involved. Instead of been seen as an additional burden, health and safety responsibilities should be seen as an opportunity to innovate and change (Suraji, 2006). A construction industry that can control their health and safety record is in a good position to compete in an increasingly dynamic and competitive world economy. Given the fragmented nature and dynamic working patterns of the construction industry, the use of virtual classes

for training and education could prove an innovative and much needed solution (Suraji, 2006).

RESEARCH METHODOLOGY

A case study methodology has been used as part of the empirical approach to evaluating and deploying the recourses used for health and safety training in the construction area. The case study approach as a research strategy can be used in different situations to contribute to knowledge of individual, group, organisation, social, political and related phenomena Yin, 2003, cited in (Wall, 2007).

The development and refinement of the research phases are based on an action research methodology. An action research methodology aims to solve current practical problems while expanding specific knowledge (Baskerville, 2004). Put simply action research is essentially "learning by doing". The cycles of action research are illustrated in figure 4. As there has been little research on the development of an educational framework for virtual classes the action research methodology allows for an effect model that can be refined and developed.

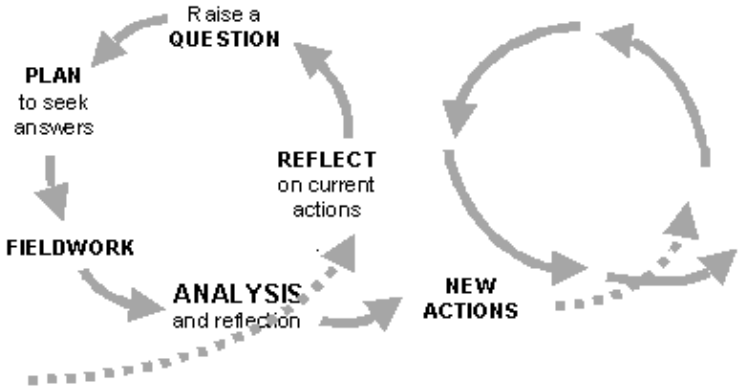

Figure 4: The Cycles of Action Research {Wall, 2007 #18}

VIRTUAL CLASS FRAMEWORK

The primary aim of this research is to develop a framework for virtual classes that is based on MI theory for health and safety training. In order to achieve that aim the project has attempted to adapt and utilize MI theoretical learning principles and use them in a virtual class environment that targets construction professionals .

To successfully test the framework being developed, it was necessary to create a virtual class directly focused on a key area of construction health and safety. As identified from Irish health and safety statistics falls from height are the leading cause of accidental death on Irish construction sites (McDonald *et al.*, 2002, Wall *et al.*, 2007, CSO, 2006).

The overall framework is made up of the delivery facets offered by virtual classes, the content presentation options offered by virtual class environment and the instructor, and the guiding educational philosophy offered by MI. The learning objectives of health and safety training provide basis to analyzing the framework as a whole.

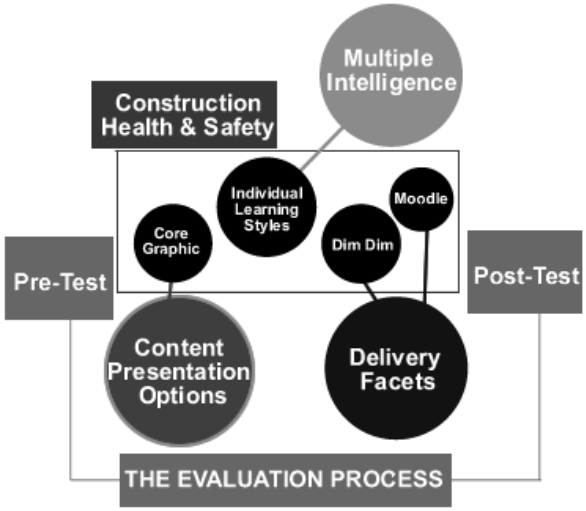

Figure 5: The Virtual Class Framework

There are a number of challenges to delivering safety training through a virtual class. They include content presentation, delivery facets and the incorporation of MI principles. There is also the method of evaluation that is used to gauge the learners satisfaction with the virtual classes approach. In order to meet the technological aspects the virtual class web based systems called Moodle and DimDim were used to meet the synchronous and asynchronous requirements. A core graphic has been developed incorporating MI principles to deliver the learning content and objectives of falls from height in the construction industry. Figure 5 identifies the key components of a virtual class framework and their relationship in the theoretical structure.

DELIVERY FACETS

When developing a virtual class one of the most important decisions is which learning management system (LMS) to use. The LMS allows access to educational content and provides the link between the learners and the instructor (Cole and Foster, 2007). The project partners decided to use the open source Moodle system as the LMS, as it is flexible, inexpensive and suitable to the projects requirements. The Moodle LMS is a server based system which allows learners and instructors to access and modify educational content through a website from anywhere connected to the internet.

In order to explore the interactive side of virtual classes the project has decided to use a web based program called Dim Dim which plugs into Moodle. Dim Dim is a web based program which allows for advanced collaboration of voice over internet protocol (VOIP), video, text and teaching mediums such as Power Point presentations. Dim Dim allows all the members of the virtual to interact in real time providing the benefits of a face-to face classroom in a virtual environment. Due to Moodle's open source design Dim Dim can be "plugged into" Moodle and be accessed as part of Moodle's content. Figure 6 compares the instructional activities available through Moodle and Dim. Moodle covers the asynchronous activities such as presenting lesson content and controlling quizzes and assignments. Dim Dim is used for synchronous instructional activities such as application sharing and multi user text and audio chat.

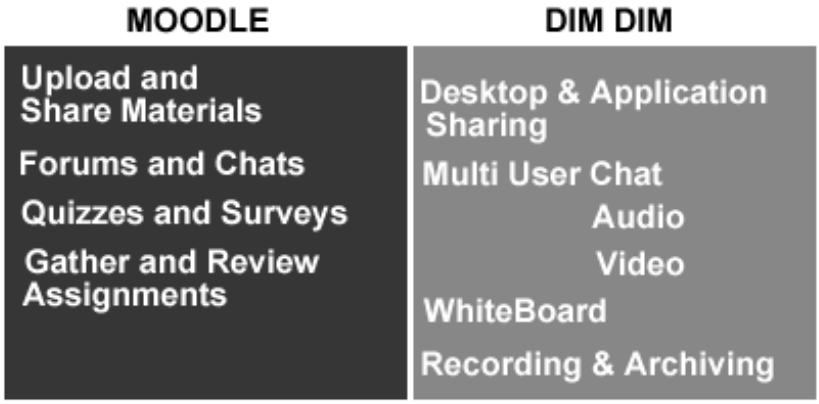

Figure 6: Comparison of Dim Dim and Moodle Features

MI TENANTS

The Multiple Intelligences (MI) framework was introduced by Howard Gardner of Harvard University in the early 1980s, it postulated that individuals possess several independent ability areas or learning styles (Gardner, 1983). Gardner defined intelligence as the capacity to solve problems or to fashion products that are valued in one or more cultural settings. Cantu (2000) argues that the key to the successful dissemination of Gardner's MI model was that it is not a prescriptive model but, but instead an approach to teaching and learning that allows for individual interpretation, design and implementation.

Gardners eight intelligences are shown in Table 2. Each intelligence is matched with an example of an instructional activity which would be suitable for a virtual class.

Table 2 -Instructional activities to be integrated with the Virtual Class (Acar et al., 2008).

Intelligence	Examples of instructional activities
Linguistic	Writing, editing, discussion (i.e., writing a set of instructions on identifying hazards, critique written resources such as relevant safety reports)
Logical / mathematical	Analyzing relevant statistical data, creating graphic representations (charts, diagrams, etc.); devising a strategy to identify hazards of falls; conducting relevant measurements
Spatial / Visual	Matching illustrations, photos or cartoons with corresponding subject categories; creating/evaluating site layouts (i.e.'safe workplaces')
Bodily / Kinesthetic	Simulations, analysis of workpace/site ergonomics
Musical / Rhythmic	Audio visual elements, designing powerpoint presentations which incorporate music and visual elements
Naturalistic	Computer simulated spaces/environments, cities, maps, illustrations, etc.
Interpersonal	Activities that might be designed to incorporate cooperative learning groups
Intrapersonal	Activities that might be completed through reflective individual projects

CONTENT PRESENTATION

The presentation of education content has an impact on the learners satisfaction of a virtual clas s (Eom et al., 2006). By being aware of the intelligences or learning styles that individuals use, content can be presented in ways that are accessible to a group with varying learning styles. The pilot class was focused on the causes of falls from height on construction sites. Due to the content focus the project partners used an interactive image of an actual construction site called a core graphic to illustrate the

causes of falls from height in their context . The core graphic become the central tool to implement the instructional activities as outlined in table 2.

EVALUATION

In order to get a picture of the effectiveness of the virtual class an evaluation processes was used. There was a pre-test and post-test completed by the learner before and after the virtual class. The analysis of the pre-test and post-test results provided a picture of the learners knowledge of the learning objectives. The key learning out come from the training was to be able to identify the hazards from falls from heights. The pre-test and post-test questions were designed to quantify the student's ability to identify hazards. The content of the course then touched on all the hazards the student where asked to identify. This allowed comparison between pre test and post test and quantify the effectiveness of the class(Leon *et al*., 2003).

CONCLUSION

The use of a virtual class framework that utilizes MI principles is an innovative approach to delivering health and safety training in the construction industry. As the internet is becoming a more widely used medium for education, virtual class could be a solution to the construction industries poor safety record (Eom *et al*., 2006).

The action research methodology chosen for the research is effective in providing a flexible basis to evaluating the virtual class framework and making changes as needed. A key element of the action research methodology is the evaluation process used to feed into the development of the next phase of the virtual class framework. The evaluation process will be made up from the feed back from participants in pilot virtual classes and the research findings of project members.

Upon completion the project will be able to provide relevant information on the practical challenges for delivering a virtual class integrating MI theory. The beneficiaries of this information would be construction professionals working in the industry, instructors working in educational institutions and future researchers.

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